WEST Search History

DATE: Thursday, September 26, 2002

Set Name side by side	Query	Hit Count	Set Name result set
DB=JPAB; PLUR=NO; OP=OR			
L62	l60 and (image adj1 file)	23	L62
L61	L60 and l59	1	L61
L60	(index adj1 image)	349	L60
L59	(display adj1 control adj1 file)	6	L59
L58	L57 and (index adj1 image)	0	L58
L57	(image adj1 creat$)	251	L57
DB=USPT; PLUR=NO; OP=OR			
L56	L55 and l7	2	L56
L55	L54 and l3	48	L55
L54	707/104.1	1629	L54
L53	L52 and (image adj1 file)	2	L53
L52	L50 and l3	43	L52
L51	L50 and l7	1	L51
L50	((707/10)!.CCLS.)	1983	L50
L49	L48 and (single adj1 picture)	0	L49
L48	l44 and l7	11	L48
L47	l44 and l18	0	L47
L46	L45 and l7	3	L46
L45	L44 and l3	128	L45
L44	((707/1 |707/2 |707/3)!.CCLS.)	3216	L44
L43	((707/1)!.CCLS.)	1180	L43
L42	L36 and l7	1	L42
L41	L40 and l7	0	L41
L40	L39 and client	67	L40
L39	L36 and server	92	L39
L38	L36 and l1	0	L38
L37	L36 and l22	0	L37
L36	((345/744)!.CCLS.)	156	L36
L35	l18 and l3	0	L35
L34	l25 and (web adj1 page)	8	L34
L33	L32 and (image adj1 file)	1	L33
L32	L31 and client	25	L32
L31	L25 and server	43	L31

091 451, 440

L30	L25 and (display adj1 file)	3	L30
L29	L25 and (single adj1 picture)	0	L29
L28	L25 and l7	0	L28
L27	L25 and l3	1	L27
L26	L25 and l22	1	L26
L25	((345/968)!.CCLS.)	107	L25
L24	L22 and l3	5	L24
L23	L22 and l7	0	L23
L22	(searching adj1 server)	28	L22
L21	l3 and l18	0	L21
L20	l18 and l7	0	L20
L19	L18 and (image adj1 file)	0	L19
L18	(display adj1 control adj1 file)	12	L18
L17	L16 and (display adj1 control adj1 file)	0	L17
L16	l7 and (single adj1 picture)	28	L16
L15	l3 and (single adj1 picture)	2	L15
L14	l3 and (search$ adj1 section)	0	L14
L13	l3 and (receiv$ adj1 section)	7	L13
L12	l7 and (search adj1 section)	0	L12
L11	l7 and (search$ adj1 section)	1	L11
L10	l7 and (receiv$ adj1 section)	4	L10
L9	l7 and l4	0	L9
L8	l7 and l3	10	L8
L7	(index adj1 image)	599	L7
L6	(index adj1 creat$ adj1 unit)	2	L6
L5	(index adj1 creat$ adj1 module)	2	L5
L4	(index adj1 creat$ adj1 section)	2	L4
L3	(index adj1 creat$)	503	L3
L2	L1 and image	1	L2
L1	(mediation adj1 server)	4	L1

END OF SEARCH HISTORY

Search Results

Search Results for: [index image and image file and search and client and server]
Found 1 of 101,750 searched. > Rerun within the Portal

Search within Results

Results 1 - 1 of 1 **short listing**

1 Object-based navigation: an intuitive navigation style for content-oriented integration environment 77%
Kyoji Hirata , Sougata Mukherjea , Yusaku Okamura , Wen-Syan Li , Yoshinori Hara
Proceedings of the eighth ACM conference on Hypertext April 1997

Results 1 - 1 of 1 **short listing**

09/451,446

Search Results

Search Results for: [index image and creation and client and server]
Found 3 of 101,750 searched. → Rerun within the Portal

Search within Results

1 Architecture of a networked image search and retrieval system 80%
R. Weber , J. Bollinger , T. Gross , H.-J. Schek
Proceedings of the eighth international conference on Information and knowledge management November 1999
Large scale networked image retrieval systems face a number of problems that are not fully satisfied by current systems. On one hand, integrated solutions that store all image data centrally are often limited in terms of scalability and autonomy of data providers. On the other hand, WWW-based search engines proved to be fairly scalable, and data providers retain their autonomy. However, such engines often confront users with links to servers that are not available or to images that no longe ...

2 Object-based navigation: an intuitive navigation style for content-oriented integration environment 77%
Kyoji Hirata , Sougata Mukherjea , Yusaku Okamura , Wen-Syan Li , Yoshinori Hara
Proceedings of the eighth ACM conference on Hypertext April 1997

3 Vision: a digital video library 77%
Wei Li , Susan Gauch , John Gauch , Kok Meng Pua
Proceedings of the first ACM international conference on Digital libraries April 1996

US006119135A

United States Patent [19]

Helfman

[11] Patent Number: 6,119,135

[45] Date of Patent: Sep. 12, 2000

[54] **METHOD FOR PASSIVELY BROWSING THE INTERNET USING IMAGES EXTRACTED FROM WEB PAGES**

[75] Inventor: **Jonathan Isaac Helfman**, Albuquerque, N. Mex.

[73] Assignee: **AT&T Corporation**, New York, N.Y.

[21] Appl. No.: **08/784,277**

[22] Filed: **Jan. 15, 1997**

Related U.S. Application Data

[60] Provisional application No. 60/011,435, Feb. 9, 1996.

[51] **Int. Cl.**[7] **G06F 17/30**

[52] **U.S. Cl.** **707/513**; 707/501; 709/218

[58] **Field of Search** 707/513, 501, 707/526; 345/302; 709/203, 218

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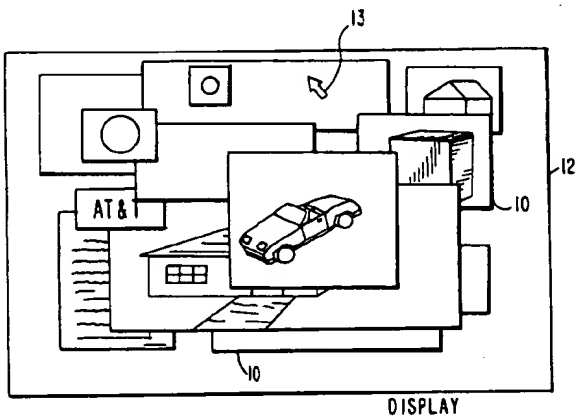
Primary Examiner—Mark R. Powell
Assistant Examiner—J. Rossi
Attorney, Agent, or Firm—Kenyon & Kenyon

[57] **ABSTRACT**

A technique is provided for passively browsing the Internet or an intranet by displaying images from web pages on a user's display screen. The user can select an image by clicking on it using a pointer manipulated by a mouse or trackball. A mapping list is maintained that maps the image universal resource locator (URL) for each image to the URL of the web page containing the image. Using the mapping list, the user's web browser can be driven to the web page associated with the image selected by the user. A group of web pages may be defined based on the results of a search, by entering URLs for sites or web pages of interest, using a bookmarks file, based on the currently displayed web page in a web browser, or by determining which web pages are associated with the images stored in an image cache.

20 Claims, 9 Drawing Sheets



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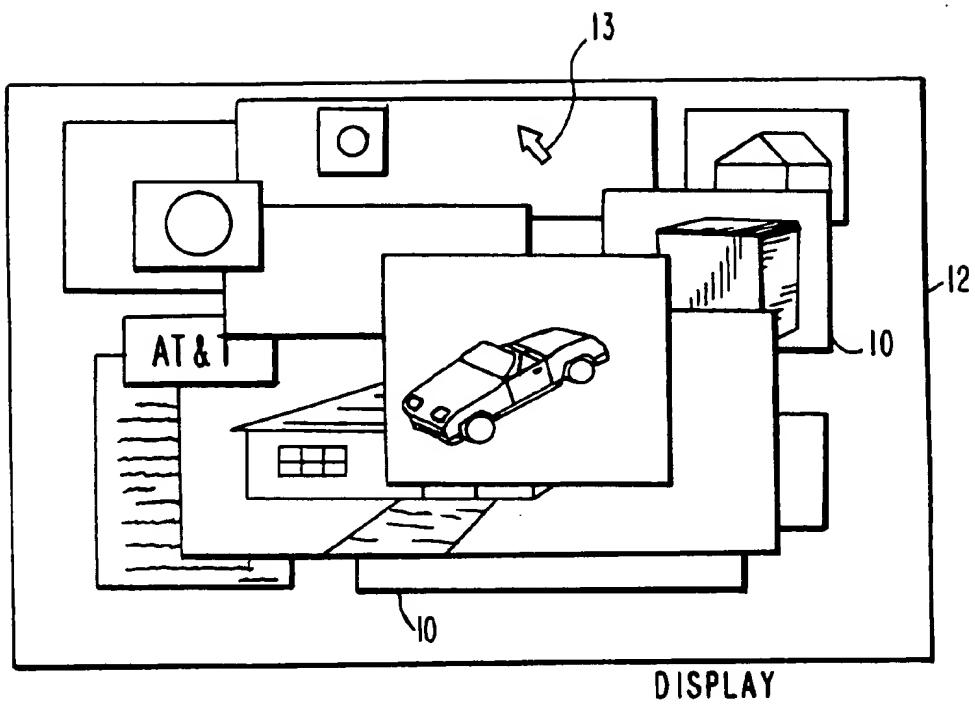

FIG. 1

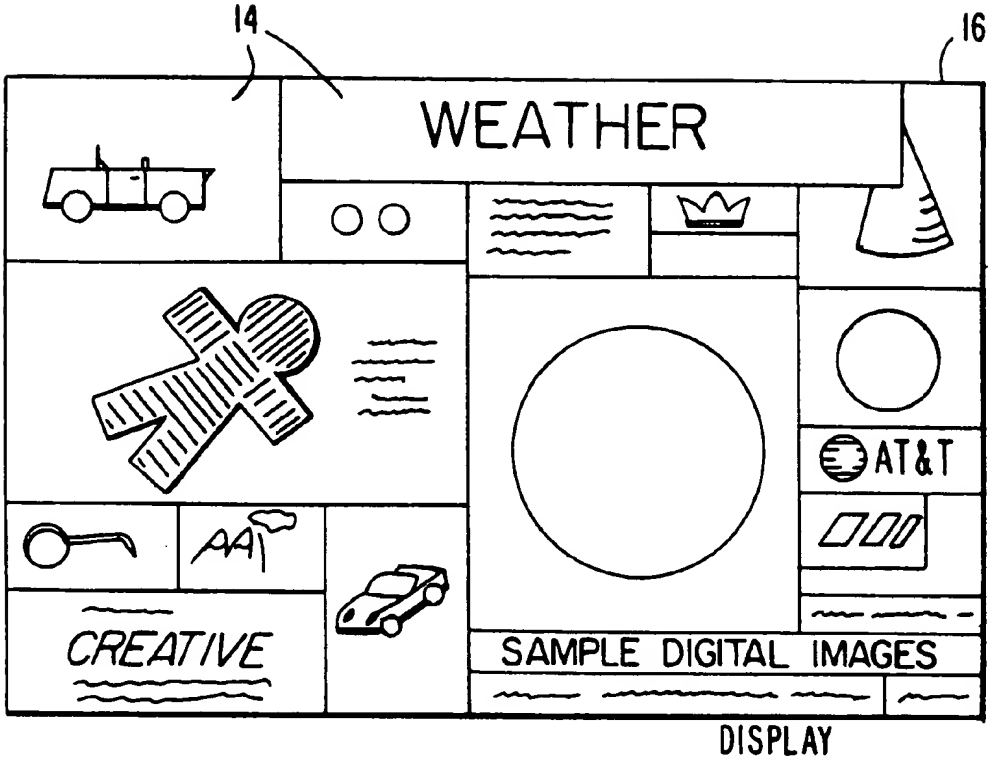
14
16
WEATHER
AT&T
AAA
CREATIVE
SAMPLE DIGITAL IMAGES
DISPLAY

FIG. 2

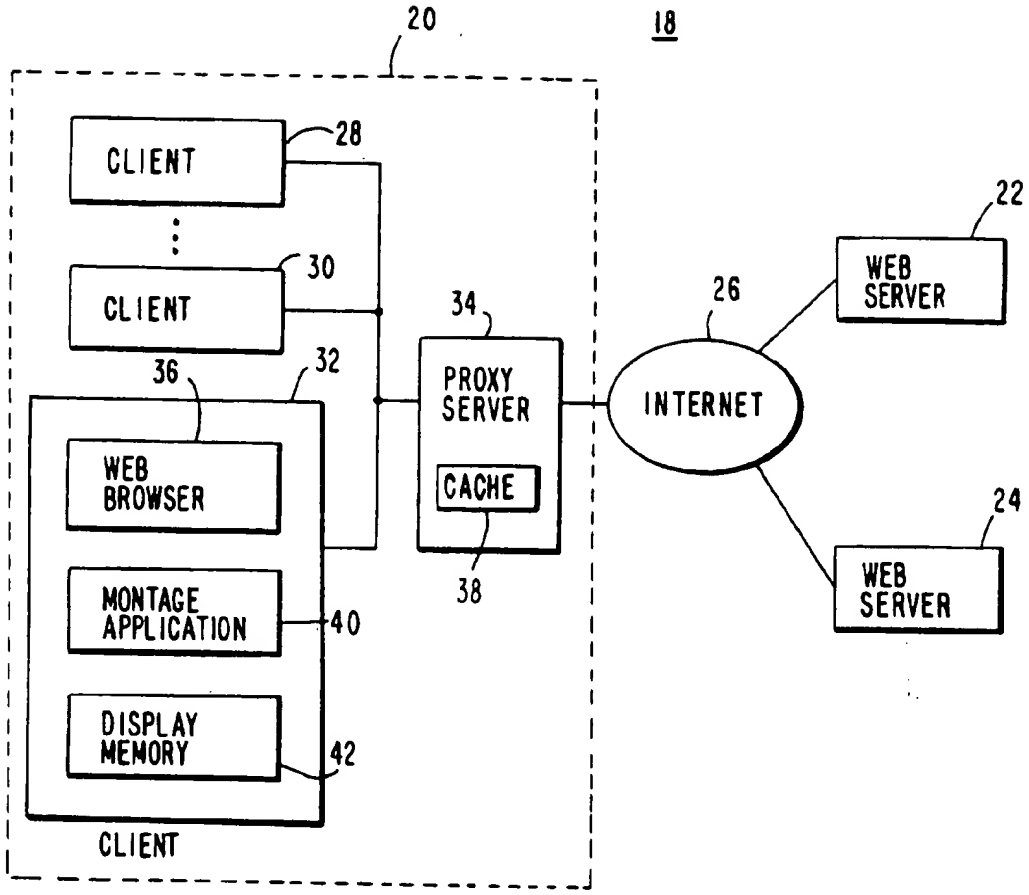
20
18
CLIENT
28
CLIENT
30
36
32
WEB BROWSER
MONTAGE APPLICATION
40
DISPLAY MEMORY
42
CLIENT
34
PROXY SERVER
CACHE
38
26
INTERNET
22
WEB SERVER
24
WEB SERVER

FIG. 3

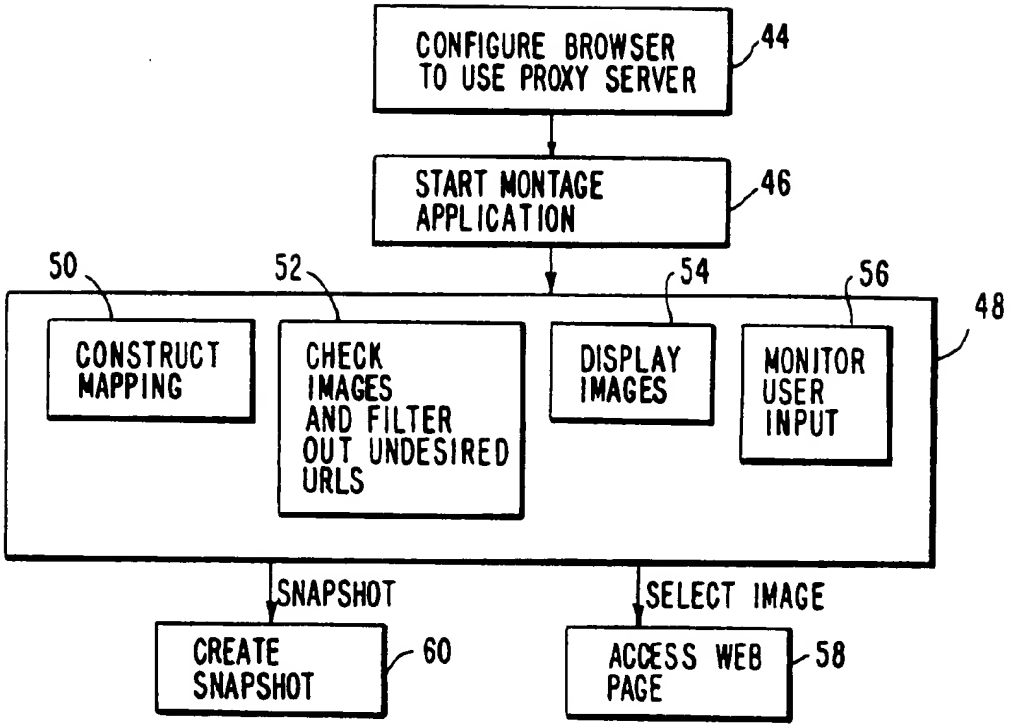
CONFIGURE BROWSER TO USE PROXY SERVER
44
START MONTAGE APPLICATION
46
50
52
54
56
48
CONSTRUCT MAPPING
CHECK IMAGES AND FILTER OUT UNDESIRED URLS
DISPLAY IMAGES
MONITOR USER INPUT
SNAPSHOT
SELECT IMAGE
CREATE SNAPSHOT
60
ACCESS WEB PAGE
58

FIG. 4

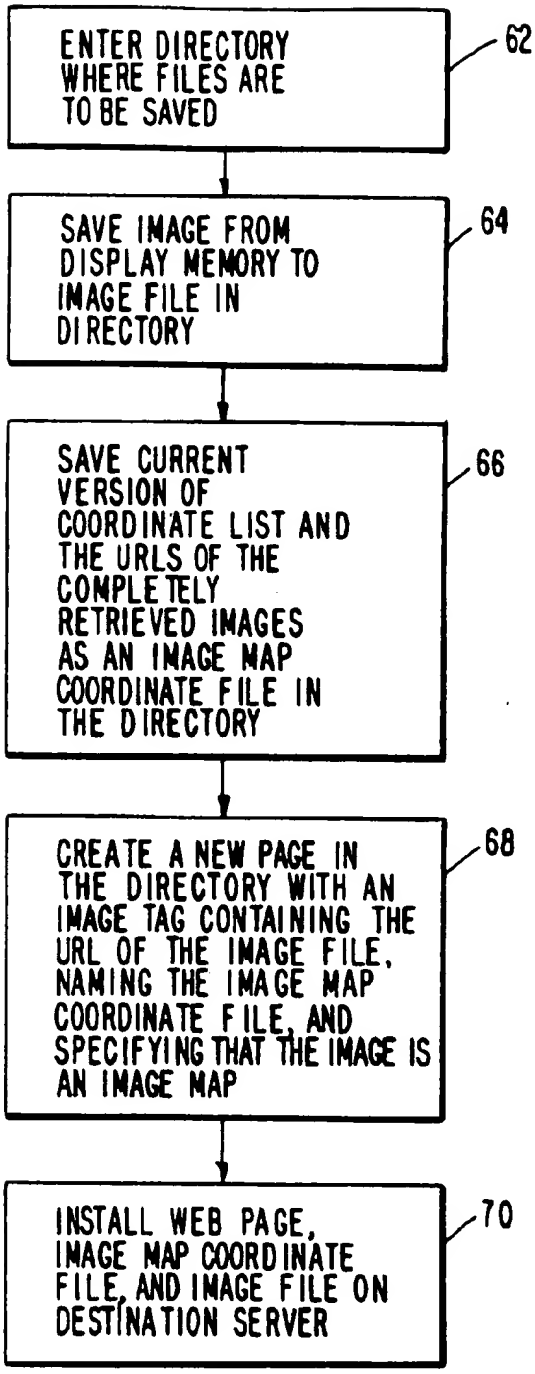
ENTER DIRECTORY WHERE FILES ARE TO BE SAVED
62
SAVE IMAGE FROM DISPLAY MEMORY TO IMAGE FILE IN DIRECTORY
64
SAVE CURRENT VERSION OF COORDINATE LIST AND THE URLS OF THE COMPLETELY RETRIEVED IMAGES AS AN IMAGE MAP COORDINATE FILE IN THE DIRECTORY
66
CREATE A NEW PAGE IN THE DIRECTORY WITH AN IMAGE TAG CONTAINING THE URL OF THE IMAGE FILE, NAMING THE IMAGE MAP COORDINATE FILE, AND SPECIFYING THAT THE IMAGE IS AN IMAGE MAP
68
INSTALL WEB PAGE, IMAGE MAP COORDINATE FILE, AND IMAGE FILE ON DESTINATION SERVER
70

FIG. 5

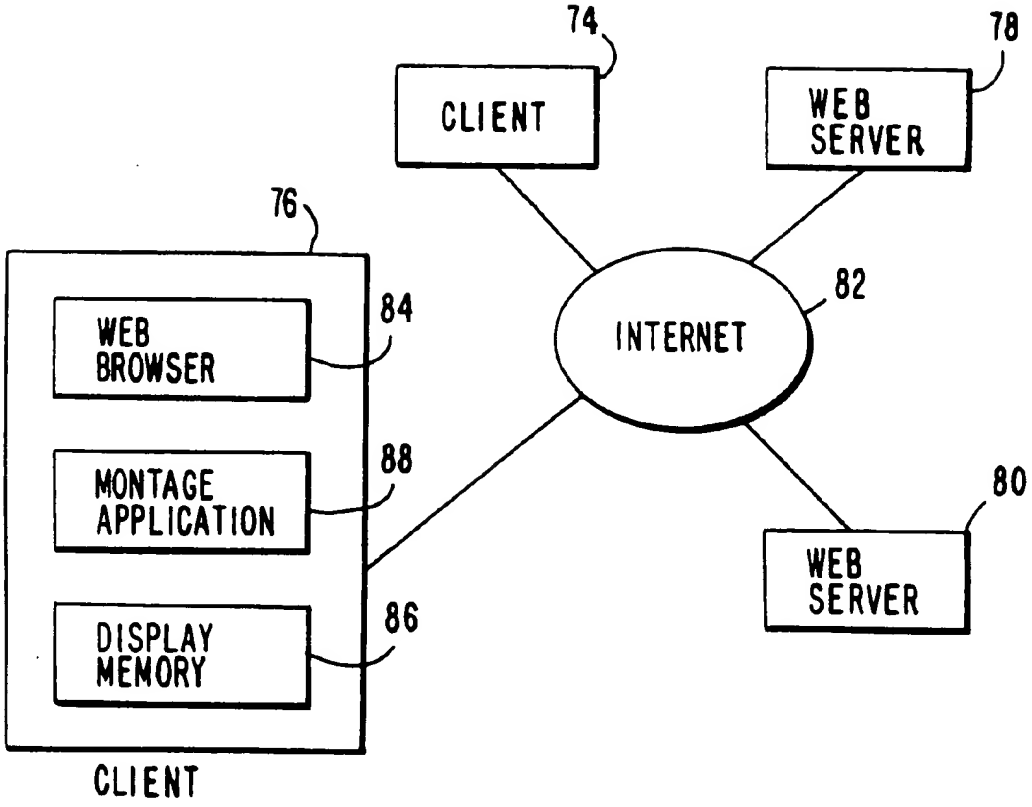
74
CLIENT
78
WEB SERVER
76
WEB BROWSER
84
INTERNET
82
MONTAGE APPLICATION
88
80
WEB SERVER
DISPLAY MEMORY
86
CLIENT

FIG. 6

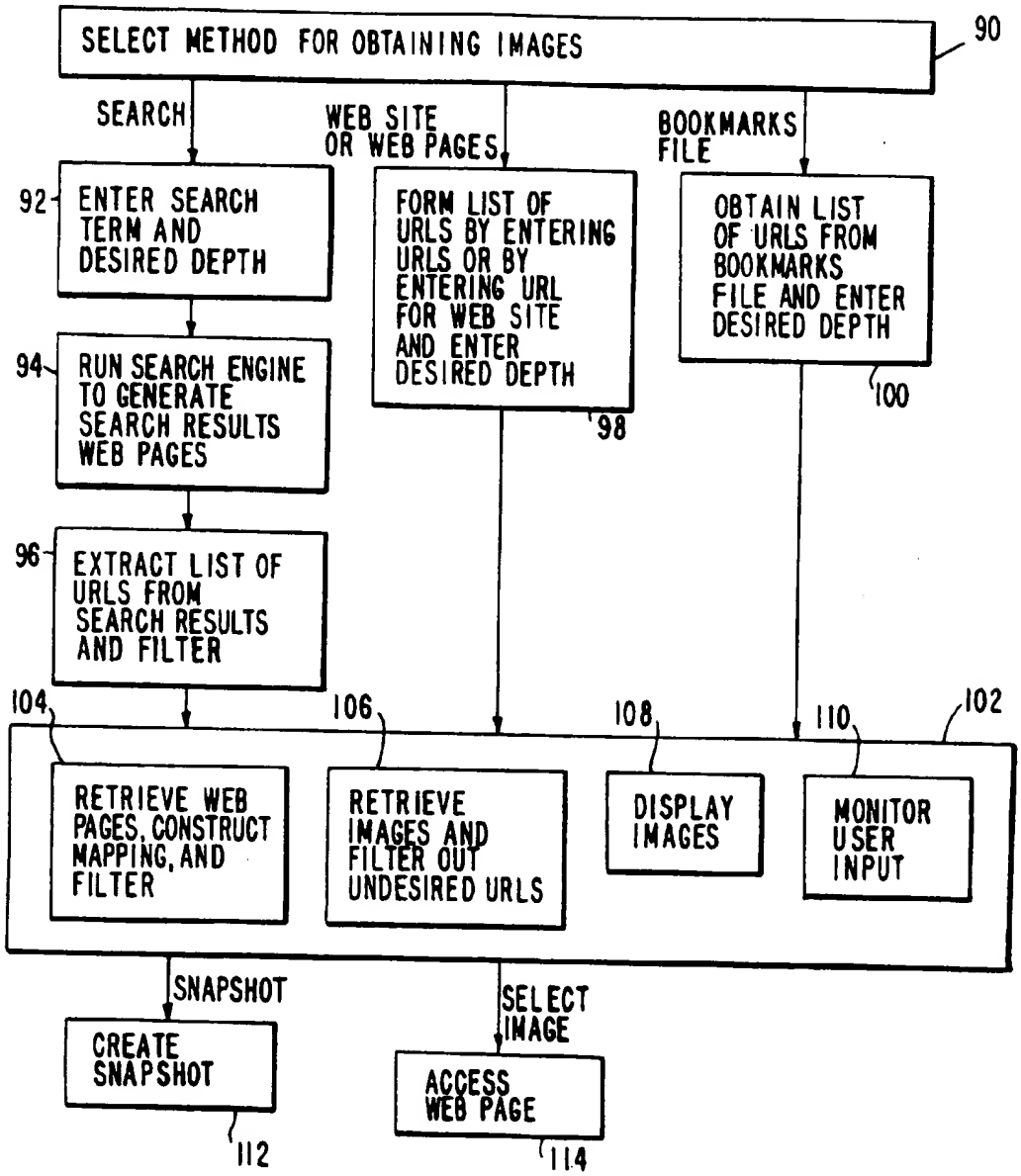
SELECT METHOD FOR OBTAINING IMAGES
90
SEARCH
WEB SITE OR WEB PAGES
BOOKMARKS FILE
92
ENTER SEARCH TERM AND DESIRED DEPTH
94
RUN SEARCH ENGINE TO GENERATE SEARCH RESULTS WEB PAGES
96
EXTRACT LIST OF URLS FROM SEARCH RESULTS AND FILTER
FORM LIST OF URLS BY ENTERING URLS OR BY ENTERING URL FOR WEB SITE AND ENTER DESIRED DEPTH
98
OBTAIN LIST OF URLS FROM BOOKMARKS FILE AND ENTER DESIRED DEPTH
100
104
106
108
110
102
RETRIEVE WEB PAGES, CONSTRUCT MAPPING, AND FILTER
RETRIEVE IMAGES AND FILTER OUT UNDESIRED URLS
DISPLAY IMAGES
MONITOR USER INPUT
SNAPSHOT
SELECT IMAGE
CREATE SNAPSHOT
112
ACCESS WEB PAGE
114

FIG. 7

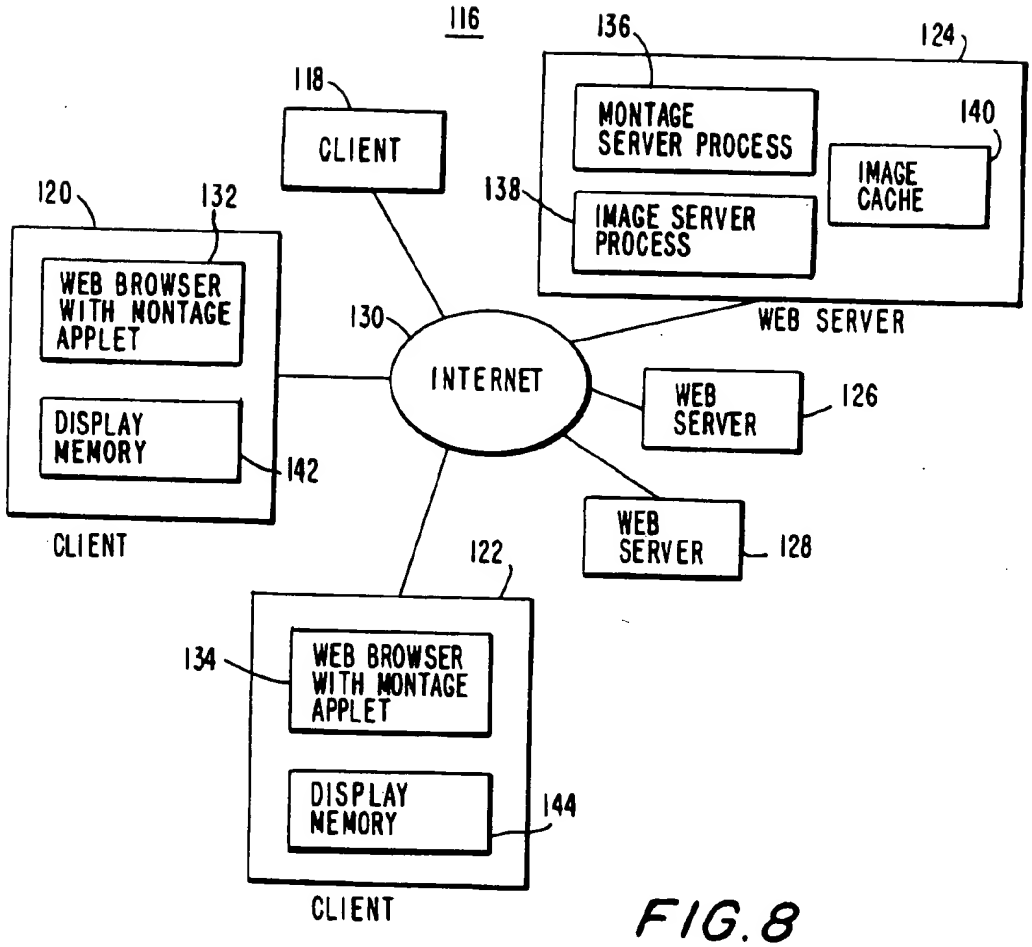
116
136
124
118
CLIENT
MONTAGE SERVER PROCESS
140
IMAGE CACHE
120
132
138
IMAGE SERVER PROCESS
WEB BROWSER WITH MONTAGE APPLET
130
INTERNET
WEB SERVER
DISPLAY MEMORY
142
126
WEB SERVER
CLIENT
128
122
134
WEB BROWSER WITH MONTAGE APPLET
DISPLAY MEMORY
144
CLIENT

FIG. 8

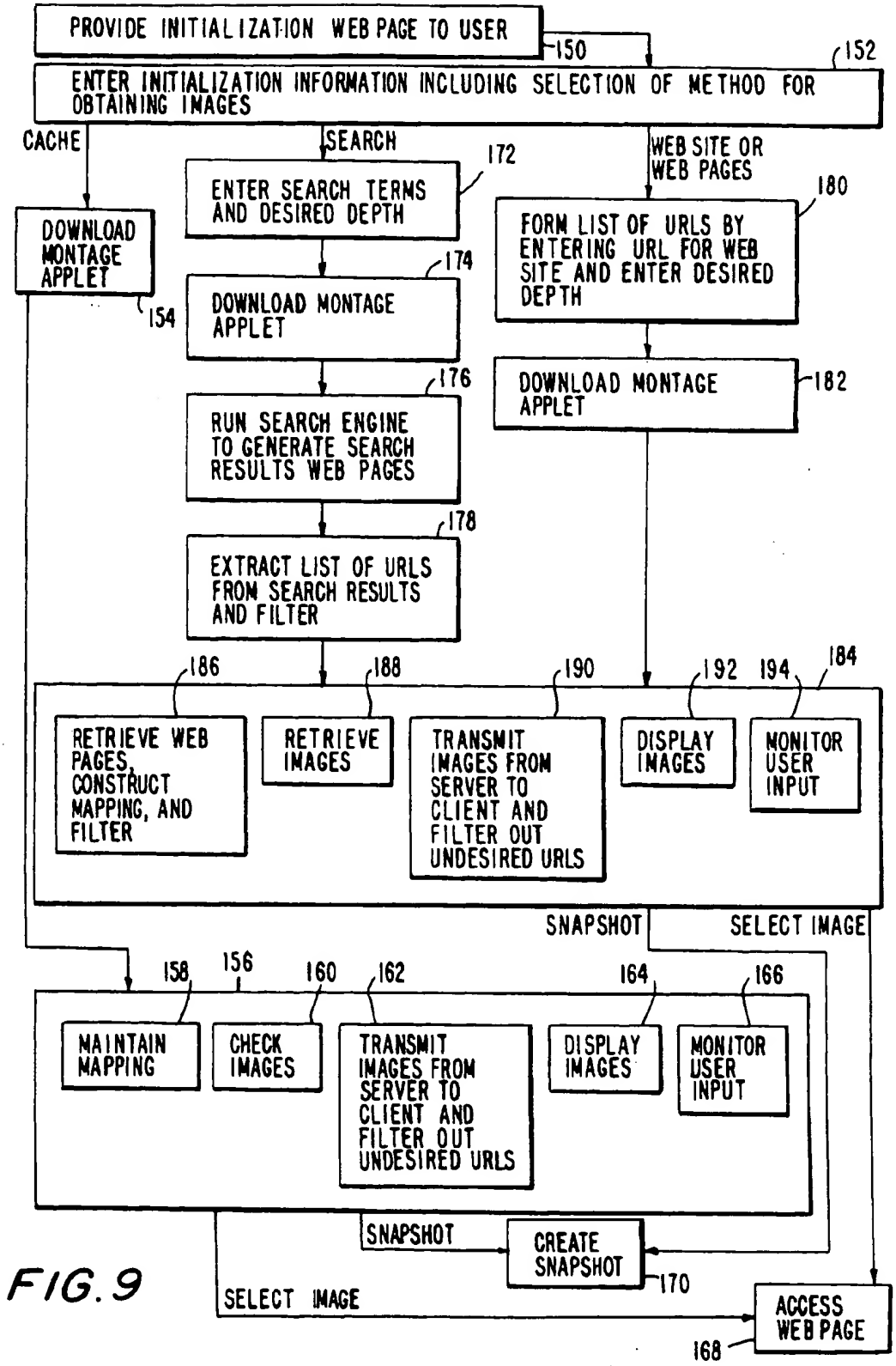
PROVIDE INITIALIZATION WEB PAGE TO USER
150
152
ENTER INITIALIZATION INFORMATION INCLUDING SELECTION OF METHOD FOR OBTAINING IMAGES
CACHE
SEARCH
WEB SITE OR WEB PAGES
172
ENTER SEARCH TERMS AND DESIRED DEPTH
180
FORM LIST OF URLS BY ENTERING URL FOR WEB SITE AND ENTER DESIRED DEPTH
DOWNLOAD MONTAGE APPLET
154
174
DOWNLOAD MONTAGE APPLET
DOWNLOAD MONTAGE APPLET
182
176
RUN SEARCH ENGINE TO GENERATE SEARCH RESULTS WEB PAGES
178
EXTRACT LIST OF URLS FROM SEARCH RESULTS AND FILTER
186
188
190
192
194
184
RETRIEVE WEB PAGES, CONSTRUCT MAPPING, AND FILTER
RETRIEVE IMAGES
TRANSMIT IMAGES FROM SERVER TO CLIENT AND FILTER OUT UNDESIRED URLS
DISPLAY IMAGES
MONITOR USER INPUT
SNAPSHOT
SELECT IMAGE
158
156
160
162
164
166
MAINTAIN MAPPING
CHECK IMAGES
TRANSMIT IMAGES FROM SERVER TO CLIENT AND FILTER OUT UNDESIRED URLS
DISPLAY IMAGES
MONITOR USER INPUT
SNAPSHOT
CREATE SNAPSHOT
170
SELECT IMAGE
ACCESS WEB PAGE
168

FIG. 9

METHOD FOR PASSIVELY BROWSING THE INTERNET USING IMAGES EXTRACTED FROM WEB PAGES

This application claims the benefit of U.S. provisional application No. 60/011,435, filed Feb. 9, 1996.

FIELD OF THE INVENTION

This invention relates to data networks such as the Internet and intranets, and more particularly, to passively browsing for information by viewing images.

BACKGROUND OF THE INVENTION

A frustrating aspect of the information revolution is that the ease of accessing on-line material has not kept pace with the growth in the amount of material that is available. For example, advances in hardware, compression techniques, editing tools, and web browsers have facilitated the creation of material containing inlined images (images that appear on a web page with text). Inlined images are a popular way in which to create eye-catching text and graphics that would be difficult or impossible to create using the capabilities of hypertext markup language (HTML). However, accessing web pages with interesting inlined images typically involves browsing through web pages of material by clicking on hypertext links. Although browsing in this way is often rewarding, it requires a good deal of attention on the part of the person who is browsing and can be burdensome.

It is therefore an object of the present invention to provide a way in which to facilitate the access and display of Internet or intranet images and the material associated with the images.

SUMMARY OF THE INVENTION

This and other objects of the invention are accomplished in accordance with the principles of the present invention by providing a system in which a user can display web page images on a computer screen. When the user is interested in a particular image, the user can select the displayed image by clicking on it with a mouse or trackball.

The system maintains a mapping list that maps the universal resource locator (URL) of the displayed web page images to the URL of the web page containing those images. When a user selects a displayed image, the user's browser is driven to the associated web page, so that the user can view the web page in its entirety.

The group of web pages containing the images to be displayed can be obtained in various ways. For example, a search engine can be used to locate web pages based on certain search criteria. Web page or web site URLs can be entered manually or by using a cut and paste operation from an application running in an open window. A bookmarks file containing various URLs can also be used to define a group of web pages. Web pages can be obtained based on the URL for the currently displayed page in an active web browser. A recursive retrieval process can be used to obtain multiple groups of linked web pages. Regardless of how the group of web pages is defined, the system extracts embedded image URLs from the web pages and forms a list mapping the extracted image URLs to the URLs of the web pages associated with those images.

If desired, web page images can be obtained from an image cache. For example, in a system having a proxy server connection to the Internet, images are stored in a proxy server cache whenever web pages are retrieved. The proxy server contains a log file that can be parsed to construct a list that maps images to associated web pages.

Images may be displayed on the user's display in random positions, in a non-overlapping pattern, or arranged by size, etc. The user's client computer maintains a data list of coordinates so that when the user clicks on a given image, the client can determine which image has been selected. The mapping list is used to determine which web page URL corresponds to the selected image. The user's web browser is driven to the URL of that web page.

The user can passively browse the Internet or an intranet by observing the displayed images. Web page images typically contain lively text and graphics, so it is relatively easy for users to quickly review a large amount of material. When images are obtained from an image cache or from web pages associated with the URL for a currently displayed page of an active web browser, no user input is required. When the user submits a search or a list of web page or web site URLs, only minimal user input is needed.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of an illustrative display screen on which various web page images have been displayed in random positions.

FIG. **2** is a diagram of an illustrative display screen on which various web page images have been displayed in a non-overlapping pattern.

FIG. **3** is a diagram of a system that uses a proxy server in accordance with the present invention.

FIG. **4** is a flow chart of the steps involved in using the system of FIG. **3** to display images and access associated web pages.

FIG. **5** is a flow chart of the steps involved in saving a snapshot of a number of web page images.

FIG. **6** is a diagram of a system with certain functions implemented using a local application in accordance with the present invention.

FIG. **7** is a flow chart of the steps involved in using the system of FIG. **6** to display images and access associated web pages.

FIG. **8** is a diagram of a system with certain functions implemented using processes on a server and certain functions implemented using downloaded applets in accordance with the present invention.

FIG. **9** is a flow chart of the steps involved in using the system of FIG. **8** to display images and access associated web pages.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

U.S. provisional application No. 60/011,435, filed Feb. 9, 1996, is hereby incorporated by reference herein.

In accordance with the present invention, a user with a computer connected to a data network such as the Internet or an intranet can have web page images **10** displayed on computer screen **12**, as shown in FIG. **1**. Typical images include logos, art, and pictures of products and may, in general, include text. If the user observes an image of interest, the user can select that image by clicking on the image by manipulating pointer **13** with a pointing device

such as a trackball or a mouse. When an image is selected, the user's web browser is automatically driven to the web page associated with the image. The user can browse the World Wide Web starting with that page.

Various techniques can be used to define the set of images that are presented on screen **12**. If desired, the images can be obtained from an image cache. The contents of the cache varies continually as other users browse the Web and draw different images into the cache. As new images are added to the cache, they are displayed on screen **12**. Because a variety of images are presented to the user without any user input, the user may browse the Internet or intranet passively. Another way in which to obtain images is to perform a search for web pages that meet certain predefined search criteria. The images displayed on screen **12** can be extracted from the web pages that match the search criteria. Similarly, a user can provide a list of certain universal resource locators (URLs) to define a set of web pages or web sites. The URLs can be entered by the user manually or by cutting and pasting from an application or can be supplied from a web browser's bookmarks file. The web page images are obtained from the web pages associated with the list of URLs. Web page images can also be obtained from web pages associated with the currently displayed page of an active web browser.

If desired, web page images **14** can be displayed on computer display screen **16** in a non-overlapping pattern, as shown in FIG. **2**. The pattern of FIG. **2** uses standard two-dimensional bin-packing algorithms to avoid the overlap associated with the random placement approach of FIG. **1**. Another suitable display technique involves displaying images according to size (e.g., placing the largest images in the center of the display).

Images may be obtained from an image cache using system **18** of FIG. **3**. In system **18**, multiple clients are clustered together to form a local area network **20**. Web servers **22** and **24**, which are connected to a data network such as the Internet **26** or an intranet, supply web pages to clients **28**, **30**, and **32**. Clients **28**, **30**, and **32** are connected to the Internet **26** through proxy server **34**. Proxy servers are typically used in organizations that wish to provide a firewall machine between clients in a local area network and the Internet. Clients **28**, **30**, and **32** in local area network **20** contain standard web browsers, such as web browser **36** on client **32**. Each web browser is configured to use proxy server **34** as its proxy server. When users browse the Internet **26**, the web browsers request web pages from the proxy server **34**. Proxy server **34** stores requested web pages and the images contained in or referenced from those web pages in cache **38**. If no local copy of a requested page exists in cache **38** of proxy server **34**, proxy server **34** retrieves the requested web page from the appropriate web server **22** or **24** via the Internet **26**. Proxy server **38** also maintains a standard log file containing the URLs of the stored web pages and images.

A montage application, such as montage application **40** on client **32**, may run on each client in local area network **20**, but is illustrated only as running on client **32** to avoid over-complicating the drawing. Montage application **40** parses the log file maintained by proxy server **38** and creates a corresponding mapping list containing the URLs of the images in cache **38** and the URLs of the web pages associated with those images. Montage application **40** displays the images on the display of client **32** in a random pattern (e.g., as shown in FIG. **1**), a non-overlapping pattern (e.g., as shown in FIG. **2**), or in some other suitable arrangement.

As montage application **40** displays the images, montage application **40** maintains a list of coordinates that indicate the positions in which the images have been displayed. Montage application **40** awaits user input, so that when the user clicks on a given image, montage application **40** can determine which image has been selected and can drive web browser **36** to the web page associated with that image.

Images displayed on client **32** are stored in display memory **42**. If desired, a user can save a snapshot of the currently displayed images. Information is saved with the snapshot that allows the user to click on the images within the snapshot to access the web pages associated with the images. Snapshots are preferably stored in the form of a web page. If the user wishes to share the snapshot, the user can install the web page containing the snapshot on a publicly accessible server and can provide the URL for that web page to interested parties.

The steps involved in using system **18** to display web page images and access the web pages associated with those images are shown in FIG. **4**. At step **44**, the user configures web browser **36** so that proxy server **34** is identified as the proxy server for client **32**. This type of configuration ensures that web pages accessed by the clients running the montage application in local area network **20** will be stored in cache **38** and that entries will be made in a log file associated with proxy server **34** to indicate that the web pages have been cached. A suitable web browser **36** that allows the user to adjust the proxy server setup is the Navigator web browser of Netscape Communications Corporation. At step **46**, the user starts the operation of montage application **40** (e.g., by clicking on an icon in a Microsoft Windows® environment).

At step **48**, several concurrent processes implemented by montage application **40** are performed on client **32**. In process **50**, montage application **40** parses the standard log file maintained by proxy server **34** to construct a mapping list that maps the URL for each image listed in the log file to the URL of the web page associated with that image. To construct the mapping list, the log file on proxy server **34** must be readable by montage application **40**.

In process **52**, montage application **40** determines whether the images listed in the mapping file still exist in cache **38** (i.e., the images have not been overwritten) and, if the images exist, places the URLs of the images on a list of completely retrieved images. The disk of proxy server **34** used for cache **38** is preferably network mountable, so that montage application **40** running on client **32** can mount the disk (i.e., can access the image files in cache **38** as if they were local files on client **32**). Local area network **20** preferably has standard network file system (NFS) capabilities. If desired, URLs that match text strings indicative of pornographic or otherwise offensive or unwanted content can be filtered out during process **52**.

In process **54**, montage application **40** displays the completely retrieved images from the list on the display of client **32** and maintains a list of the coordinates for each displayed image. In process **56**, montage application **40** waits for input from the user (e.g., a click on a given image).

If a user selects an image by clicking at a certain coordinate, montage application **40** determines which image has been selected from the list of coordinates maintained during process **54** and uses the mapping list constructed during process **50** to drive web browser **36** to the web page that contains the selected image at step **58**.

If a user selects the option "create snapshot," a snapshot image of the images in display memory **42** of client **32** is saved at step **60**. The steps involved in creating a snapshot are shown in more detail in FIG. **5**. The user enters the name of the directory where the snapshot data files are to be stored

at step 62. The directory can be, e.g., a local directory on a disk on client 32. At step 64, the images currently in display memory 42 are saved as a snapshot image file in the selected directory. The current version of the coordinate list data indicating the coordinates of the displayed images and the URLs of the displayed images are stored in the directory as an image map coordinate file at step 66. At step 68, a new web page is created in the directory by montage application 40. The web page includes an image tag that specifies the URL of the snapshot image file, the name of the snapshot image map coordinate file, and indicates that the snapshot image file is of the image map type. The web page is installed on a suitable web server by the user or a system administrator at step 70 using conventional web page installation techniques.

If desired, the user can "send" the snapshot to a friend, by communicating the URL of the snapshot web page to the friend (e.g., by e-mail, etc.). Because the snapshot has been installed on a web server, it may be accessed by anyone with the appropriate URL. When the accessing user clicks on a region of the snapshot image map, the user's web browser sends the coordinates of the user's selection to the web server along with the name of the image map coordinate file. The web server determines the URL of the web page associated with the selected region by searching through the image map coordinate file for the first region that contains the selected coordinates. The web server then sends back a command that drives the user's web browser to the web page associated with the image in the selected region.

In system 18 of FIG. 3, the various clients connected to proxy server 34 define a community of users. The web pages and images retrieved by the community of users are reflected in the contents of cache 38. Because montage application 40 displays the images stored in cache 38, the displayed images mirror the interests of the community of users.

Another way in which images can be displayed involves performing a search or entering web site information. In system 72, clients 74 and 76 are interconnected with web servers 78 and 80 via the Internet 82, as shown in FIG. 6. The group of web images that are displayed on clients 74 and 76 may be based on a search, a list of URLs, a bookmarks file specified by the user, or the currently displayed page of an active web browser.

Client 76 has standard web browser 84, standard display memory 86, and montage application 88. Additional clients, such as client 74, may have the same configuration as client 76, but this detail is not included in FIG. 6 to avoid over-complicating the drawing. Montage application 88, which controls the display of web page images and the access of corresponding web pages, may be implemented in the Java programming language of Sun Microsystems. If montage application 88 is implemented in Java, it is run with a Java interpreter installed on client 76. With the arrangement of FIG. 6 and standard Windows® software, the user at client 76 can run Montage application 88 in one window and web browser 84 in another window. Because system 72 does not have a proxy server for client 76, system 72 may be somewhat slower in performing certain web page retrieval operations than system 18 (FIG. 3). However, system 72 does not require clients to be configured in a communal arrangement with a single proxy server. In addition, system 72 does not require client processes to be able to access log files and data files associated with a proxy server cache.

The steps involved in using system 72 to display web page images and access the web pages associated with those images are shown in FIG. 7. At step 90, the user selects a method for obtaining web page images. For example, a user at client 76 clicks on an option presented on client 76 by montage application 88.

If the user selects the option "search," the user is provided with an opportunity to enter various search parameters at step 92. For example, the user can enter search terms for subjects of interest. Another item that the user can enter is the desired depth of web page links to be searched. At step 94, a search engine is run to generate one or more web pages of search results. At step 96, montage application 88 extracts a list of URLs from the search results web pages generated at step 94. If desired, a filter may be used at step 96 to ensure that the extracted URLs only correspond to sites other than the site of the search engine. This type of filter excludes links to commercial entities associated with the search engine service (e.g., links to Alta Vista services or Digital Equipment Corporation when the Alta Vista search engine of Digital Equipment Corporation is being used).

If the user selects the option "web site," montage application 88 provides the user the opportunity to enter URLs for web pages or web sites and a desired depth at step 98. URLs can be entered manually or may be entered with a cut and paste operation from an active application. If desired, step 98 can involve automatically deriving the URL for the currently displayed page of an active web browser. The URL can be obtained using a web browser with an Application Programmer Interface (API) that allows montage application 88 to query the web browser to determine the currently displayed page. Alternatively, the code for a web browser can be altered, so that the web browser provides montage application 88 with the URL of its currently displayed page. If desired, web browser 84 can be configured to use a dummy proxy server process (e.g., on client 76) to allow the URL of the current page to be ascertained by montage application 88.

If the user selects the option "bookmarks," montage application 88 presents the user with the opportunity to enter a desired depth and the name of various bookmarks files at step 100. Step 100 may also involve the conversion of the bookmarks files into a list of URLs, if necessary.

Several concurrent processes are performed at step 102. In process 104, montage application 88 uses the list of URLs and the desired depth to retrieve the group of web pages from which images are extracted. If the desired depth is 0, only the web pages corresponding to the URLs on the list are retrieved. If the desired depth is greater than 0, the web page retrieval process is iterated as needed. For example, if the depth is 1, web pages corresponding to links appearing on the web pages for the depth of 0 case are retrieved in addition to the web pages for the depth of 0 case. If the depth is 2, an additional layer of web pages is retrieved. As the web pages are retrieved, montage application 88 identifies the image URLs that are embedded in the web pages and constructs a mapping that associates each image URL to the URL of the web page that contains that image.

In addition, the web pages that are retrieved can be filtered during process 104. For example, montage application 88 might only retain web pages from the same site as initially entered by the user to ensure that the retrieved web pages are similar in content to the initially entered search. This filter can be used in conjunction with the type of filter used at step 96 (which excludes "same site" links). For example, during the few layers of web page retrieval the filter can exclude links to sites other than for the listed URLs, thereby ensuring that the retrieval process stays focused and is able to proceed

past the initial menu pages common with many sites. After these first few layers, the filter can exclude links to the same site, thereby maximizing the breadth of the search at this stage. The user can enter the depth for each part of the web page retrieval filtering process.

In process **106**, the image for each image URL in the mapping list is retrieved. If desired, images can be excluded during image retrieval process **106** if they correspond to web page URLs that match text strings indicative of pornographic or otherwise offensive or unwanted content. Whenever an image has been completely retrieved, that image is placed on a list of completely retrieved images.

In process **108**, montage application **88** displays the completely retrieved images from the list on the display of client **76** and maintains a list of the coordinates for each displayed image. To display images on the display, image data is placed in display memory **86**. In process **110**, montage application **88** monitors user input.

If a user selects an image by clicking at a coordinate within the image, montage application **88** determines the image URL for the selected image from the list of image coordinates maintained in process **108** and uses the mapping list constructed in process **104** to drive web browser **84** to the web page that contains the selected image at step **114**.

If a user selects the option "create snapshot," a snapshot image of the images in display memory **86** of client **76** are saved at step **112**. The step of creating the snapshot involves the steps described in connection with FIG. **5**.

Another arrangement that can be used is shown in FIG. **8**. In system **116**, clients **118**, **120**, and **122** are interconnected with web servers **124**, **126**, and **128** via the Internet **130** or an intranet. Web servers **126** and **128** provide web pages of Internet material. Web server **124** contains applets that may be downloaded by clients **118**, **120**, and **122** when it is desired to use the montage process. The downloaded applets can be combined with standard web browsers to form web browser with montage applet **132** and web browser with montage applet **134**. The operation of web server **124** is controlled by montage server process **136** and image server process **138**. The group of web images that are displayed on the clients by montage applets **132** and **134** may be obtained from image cache **140** or may be based on a search, a list of URLs, or a bookmarks file specified by the user.

Clients **118**, **120**, and **122** have standard display memories, such as display memories **142** and **144**. Web browser with montage applet **132** and web browser with montage applet **134** (hereinafter montage applets) control the display of web page images and the accessing of corresponding web pages and are preferably implemented in the Java programming language of Sun Microsystems. The arrangement of FIG. **8** allows an interested user to download and run the code for the montage process without having a Java interpreter. In addition, the arrangement of FIG. **8** allows clients **118**, **120**, and **122** to be geographically remote from each other and from web server **124**.

The steps involved in using system **116** to display web page images and access the web pages associated with those images are shown in FIG. **9**. At step **150**, web server **124** provides an initialization web page, which may be retrieved by the user at, e.g., client **122** using a standard web browser.

At step **152**, the user fills in blank fields in the initialization web page. For example, the user may be asked to supply credit card and billing information before being allowed to proceed. The user also selects the desired method for obtaining images. If the user selects the option "cache," the images are obtained from image cache memory **140**. Images are drawn into cache **140** when users at clients **118**, **120**, and **122** use montage server process **136** on web server **124** to retrieve web pages with images (e.g., from web servers **126** and **128**).

Montage applet **134** is downloaded to the client **122** at step **154** where it is automatically run by the web browser portion of web browser with montage applet **134**. Several concurrent processes are performed at step **156**. In process **158**, montage server process **136** maintains a mapping list that associates image URLs with the URLs of the web pages that contain the images. In process **160**, montage server process **136** and image server process **138** determine whether the images listed in the mapping file still exist in cache **140** (i.e., the images have not been overwritten) and, if the images exist, places the URLs of the images on a list of completely retrieved images. The completely retrieved images are transmitted to montage applet **134** on client **122** by montage server process **136** during process **162**. Undesired URLs are filtered out during process **162** by comparing the text of the URLs to text strings provided by the user at client **122** that are indicative of pornographic or otherwise offensive or unwanted content. Images that correspond to undesired URLs are not transmitted to client **122** during process **162**.

Montage applet **134** displays the transmitted images on the display of client **122** and maintains a list of the coordinates for each displayed image during process **164**. In process **166**, montage applet **134** waits for user input (e.g., in the form of a click on a given image).

If a user selects an image by clicking at a certain coordinate, montage applet **134** determines which image has been selected using the list of image coordinates maintained during process **164** and uses the mapping list maintained during process **158** to drive web browser with montage applet **134** to the web page containing the selected image at step **168**.

If a user selects the option "create snapshot" during step **156**, a snapshot image of the images in display memory **144** of client **122** are saved at step **170**. The steps involved in creating a snapshot are described in connection with FIG. **5**.

If the user selects the option "search" at step **152**, the user is given an opportunity to enter search terms and a desired depth value at step **172**. The search terms and depth are preferably entered as part of the initialization information provided by the user. Step **174** involves downloading montage applet **134** from web server **124** to client **122**. At step **176**, a search engine is run by montage server process **136** based on the search terms supplied by the user. The search generates one or more web pages of search results. At step **178**, montage server process **136** extracts a list of URLs from the search results web pages generated at step **176**. If desired, a filter may be used at step **178** to ensure that the extracted URLs only correspond to sites other than the site of the search engine. Such a filter excludes links to commercial entities associated with the search engine service.

If the user selects the option "web site" at step **152**, the user is given an opportunity to enter information concerning web sites and web pages and a desired depth value as part of the initialization information, as shown by step **180**. If desired, the user can enter a URL at step **180** from the currently displayed web page of a web browser. The web site and web page URLs entered by the user form a list of URLs. Montage applet **134** for client **122** is downloaded at step **182**.

Several concurrent processes are performed at step **184**. During process **186**, server process **136** retrieves web pages based on the list of URLs obtained from step **178** or **180** and

the desired depth. Process **186** is an iterative process. If the desired depth is 0, only the web pages corresponding to the URL(s) on the list are retrieved. If the desired depth is greater than 0, additional layers of web pages are retrieved. For example, if the depth is 1, web pages corresponding to links appearing on the web pages for the depth of 0 case are retrieved in addition to the web pages for the depth of 0 case. If the depth is 2, a further layer of web pages is retrieved. As the web pages are retrieved, montage server process **136** identifies the image URLs that are embedded in the web pages and constructs a mapping list that maps each image URL to the URL of the web page associated with that image.

In process **188**, montage server process **136** passes the image URL for each image to image server process **138**, which retrieves the image. When the image has been fully retrieved, image server process **138** notifies montage server process **136** and stores the image in image cache **140**. In process **190**, montage server process **136** transmits the completely retrieved images to montage applet **134** on client **122**. If desired, images corresponding to web page URLs that match text strings indicative of pornographic or otherwise offensive or unwanted content can be excluded during process **190**. Before transmitting the images, montage server process **136** obtains the user's criteria for undesired URLs (e.g., as part of step **152**). Images corresponding to undesired URLs are then filtered out in process **190**.

In process **192**, montage applet **134** displays the transmitted images on the display of client **122** and maintains a list of the coordinates for each displayed image. To display images on the display, image data is placed in display memory **144**. During process **194**, montage applet **134** waits for input from the user.

If a user selects an image by clicking on a coordinate within the image, montage applet **134** determines the image URL for the selected image from its list of image coordinates maintained during process **192** and uses the mapping list constructed during process **186** to drive the web browser on client **122** to the web page that contains the selected image at step **168**.

If a user selects the option "create snapshot" during step **184**, a snapshot image of the images in display memory **144** of client **122** are saved at step **170**. Creating the snapshot involves steps described in more detail in connection with FIG. **5**.

With the system of FIGS. **8** and **9**, images are drawn into image cache **140** whenever a user at a client uses montage server process **136** to initiate a search or enter URLs to define a group of web pages. To make this type of arrangement captivating for users, web servers such as web server **124** may be dedicated to particular subjects. With such an arrangement, the users who view images from the image cache of a given server will be able to quickly view images that are primarily associated with the subject matter of that server.

With the proxy server cache system of FIGS. **3** and **4**, the community of users connected to proxy server **34** defines the type of images that are contained in cache **38**.

If desired, the images supported by the montage system can be moving images, such as digital video files or digital animation files. The display of the images can be initiated by the user or may be invoked automatically. For example, images from an image cache or based on a default search or URL list could be displayed in place of a screen saver. When a certain amount of time (e.g., 5 minutes) has elapsed without any input from the user, the images are placed on the display.

The foregoing is merely illustrative of the principles of this invention and various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention.

What is claimed is:

1. A method for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the method comprising the steps of:

obtaining a plurality of the images, each image being associated with one of the web pages, wherein the step of obtaining the images further comprises the substeps of,

retrieving a group of web pages based on a list of universal resource locators (URLs), and

retrieving the images associated with the group of web pages;

displaying the images on one of the clients without displaying the associated web pages;

allowing the user to select an image from among the displayed images; and

accessing the web page associated with the selected image;

wherein each web page of said group of web pages is included in said list of universal resource locators or can be accessed by following links from one of the universal resource locators in said list of universal resource locators.

2. A method for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the method comprising the steps of:

obtaining a plurality of the images, each image being associated with one of the web pages, wherein the step of obtaining the images further comprises the substeps of,

retrieving a group of web pages based on the universal resource locator (URL) of a web page currently displayed in a web browser, and

retrieving the images associated with the group of web pages;

displaying the images on one of the clients without displaying the associated web pages;

allowing the user to select an image from among the displayed images; and

accessing the web page associated with the selected image;

wherein each web page of said group of web pages can be accessed by following links from said web page currently displayed in the web browser.

3. The method defined in claim **2** wherein the step of displaying the images comprises the step of displaying images in random positions.

4. The method defined in claim **2** wherein the step of displaying the images comprises the step of displaying images in a non-overlapping pattern.

5. The method defined in claim **2** wherein the step of allowing the user to select an image from among the displayed images comprises the step of allowing a user to click on a displayed image.

6. The method defined in claim **2** wherein the step of accessing the web page associated with the selected image comprises the steps of:

determining the URL of the web page associated with the selected image; and

driving a web browser to that URL.

7. The method defined in claim 2 further comprising the step of creating a snapshot of the displayed images.

8. The method defined in claim 2 wherein the data network is the Internet, the servers are web servers, and the images are inlined images.

9. A system for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the system comprising:

means for obtaining a plurality of the images, each image being associated with one of the web pages, wherein the means for obtaining the images includes,

means for retrieving a group of web pages based on a list of universal resource locators (URLs), and

means for retrieving the images associated with the group of web pages;

means for displaying the images on one of the clients without displaying the associated web pages;

means for allowing a user to select an image from among the displayed images; and

means for accessing the web page associated with the selected image;

wherein each web page of said group of web pages is included in said list of universal resource locators or can be accessed by following links from one of the universal resource locators in said list of universal resource locators.

10. A system for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the system comprising:

means for obtaining a plurality of the images, each image being associated with one of the web pages, wherein the means for obtaining the images includes,

means for retrieving a group of web pages based on the universal resource locator (URL) of a webpage currently displayed in a web browser, and

means for retrieving the images associated with the group of web pages;

means for displaying the images on one of the clients without displaying the associated web pages;

means for allowing a user to select an image from among the displayed images; and

means for accessing the web page associated with the selected image;

wherein each web page of said group of web pages can be accessed by following links from said web page currently displayed in the web browser.

11. The system defined in claim 9 wherein the means for displaying the images comprises means for displaying images in random positions.

12. The system defined in claim 9 wherein the means for displaying the images comprises means for displaying images in a non-overlapping pattern.

13. The system defined in claim 9 wherein the means for allowing the user to select an image from among the displayed images comprises means for allowing a user to click on a displayed image.

14. The system defined in claim 9 wherein the means for accessing the web page associated with the selected image comprises:

means for determining the URL of the web page associated with the selected image; and

means for driving a web browser to that URL.

15. The system defined in claim 9 further comprising means for creating a snapshot of the displayed images.

16. The system defined in claim 9 wherein the data network is the Internet, the servers are web servers, and the images are inlined images.

17. A method for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the method comprising the steps of:

obtaining a plurality of the images, each image being associated with one of the web pages, wherein the step of obtaining the images further comprises the substeps of,

retrieving a group of web pages based on a list of universal resource locators extracted from the cache of web pages on a proxy server, and

retrieving the images associated with the group of web pages;

displaying the images on one of the clients without displaying the associated web pages;

allowing the user to select an image from among the displayed images; and

accessing the web page associated with the selected image;

wherein each web page of said group of web pages is included in said list of universal resource locators or can be accessed by following links from one of the universal resource locators in said list of universal resource locators.

18. A system for use in a communications network in which a plurality of users at clients are connected to a data network, wherein the users access web pages that have associated web page images and are stored on servers connected to the data network, the system comprising:

means for obtaining a plurality of the images, each image being associated with one of the web pages, wherein the means for obtaining the images includes,

means for retrieving a group of web pages based on a list of universal resource locators extracted from the cache of web pages on a proxy server, and

means for retrieving the images associated with the group of web pages;

means for displaying the images on one of the clients without displaying the associated web pages;

means for allowing a user to select an image from among the displayed images; and

means for accessing the web page associated with the selected image;

wherein each web page of said group of web pages is included in said list of universal resource locators or can be accessed by following links from one of the universal resource locators in said list of universal resource locators.

19. The method of claim 1 wherein the step of retrieving a group of web pages employs a depth characteristic to control the retrieval process.

20. The method of claim 2 wherein the step of retrieving a group of web pages employs a depth characteristic to control the retrieval process.

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Mukherjea et al.

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(45) **Date of Patent: Jul. 2, 2002**

(54) **METHOD AND APPARATUS FOR QUERY REFINEMENT**

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(52) **U.S. Cl.** **707/3**; 707/6
(58) **Field of Search** 707/33.6, 500, 707/501, 513, 521, 526, 104; 382/162, 165, 181

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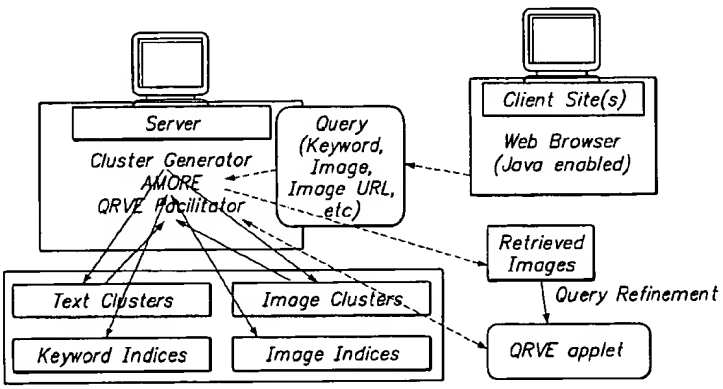
(57) **ABSTRACT**

A method and apparatus for providing a user interface for refining a query applied to a database of images, where a Query Result Visualization Environment allows the user to organize the search results using various techniques. For example, the search results may be clustered on the basis of text, image or URL. The members of the resulting clusters may then be utilized by the user to refine the query to be applied to the database of images.

40 Claims, 8 Drawing Sheets



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Peter Pirolli et al., "Silk from a Sow's Ear: Extracting Usable Structures from the Web" Proceedings fo the ACM SIGCHI '96 Conference on Human Factors in Computing Systems, pp. 118–125, Apr., 1996.

James Pitkow and Peter Pirolli, "Life, Death, and Lawfulness on the Electronic Frontier" Proceedings of the ACM SIGCHI '97 Conference on Human Factors in Computing Systems, pp. 383–390, Mar., 1997.

* cited by examiner

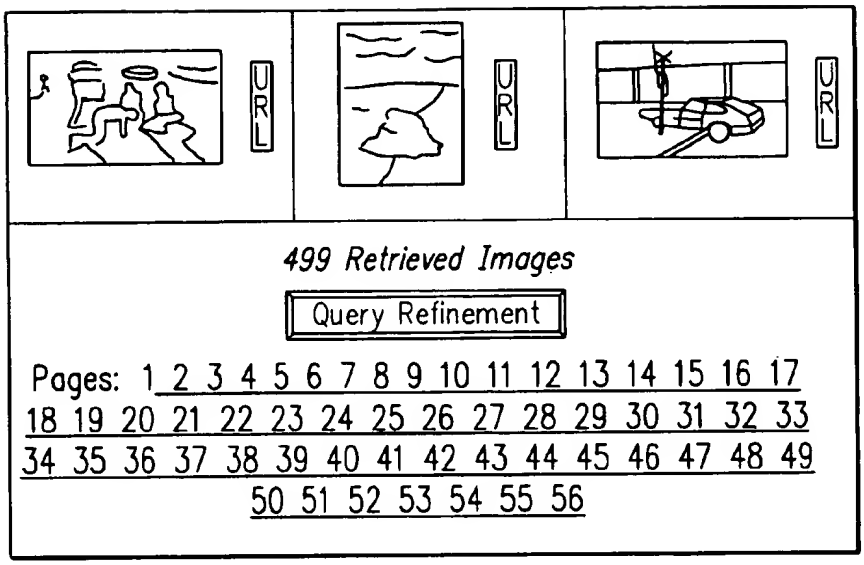

URL
URL
URL
499 Retrieved Images
Query Refinement
Pages: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
50 51 52 53 54 55 56

FIG. 1

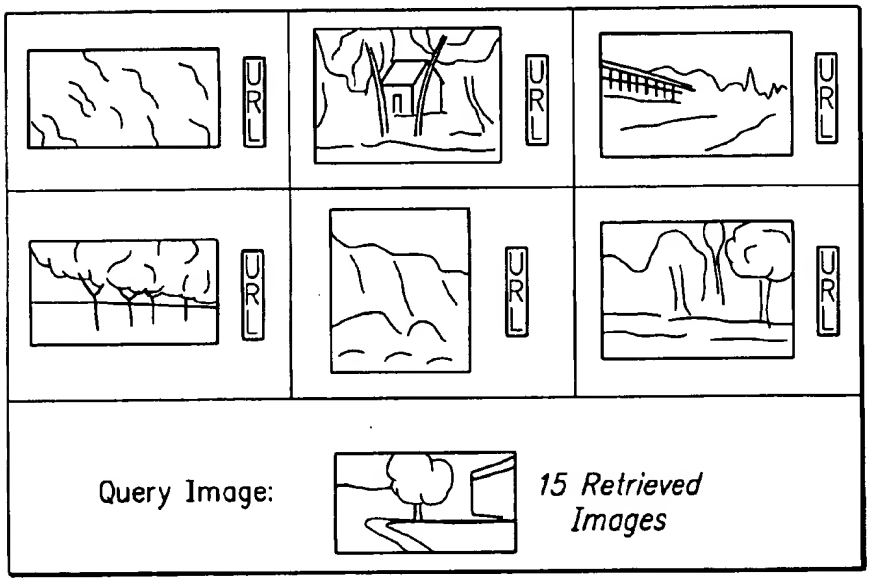

URL
URL
URL
URL
URL
URL
Query Image:
15 Retrieved Images

FIG. 2

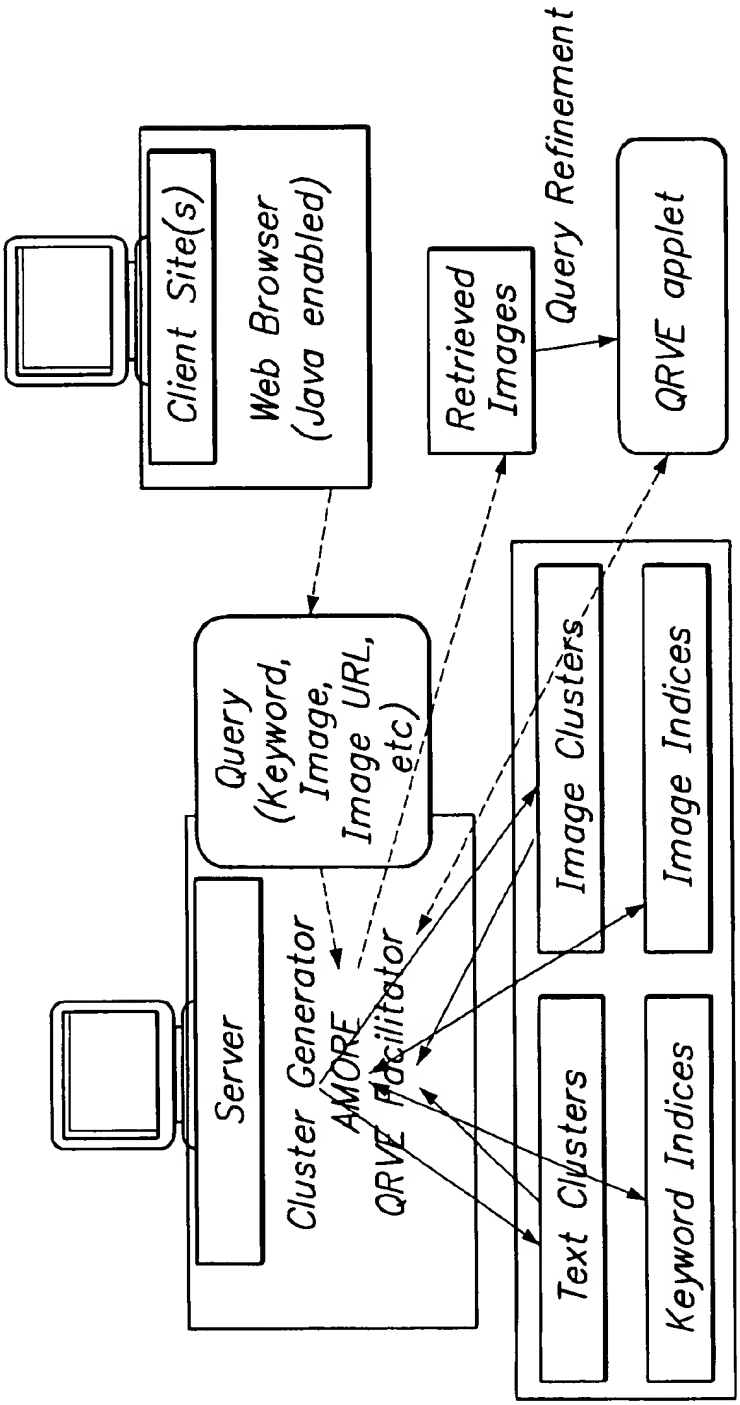

Client Site(s)
Web Browser (Java enabled)
Retrieved Images
Query Refinement
QRVE applet
Query (Keyword, Image, Image URL, etc)
Server
Cluster Generator
AMORE
QRVE Facilitator
Image Clusters
Image Indices
Text Clusters
Keyword Indices

FIG. 3

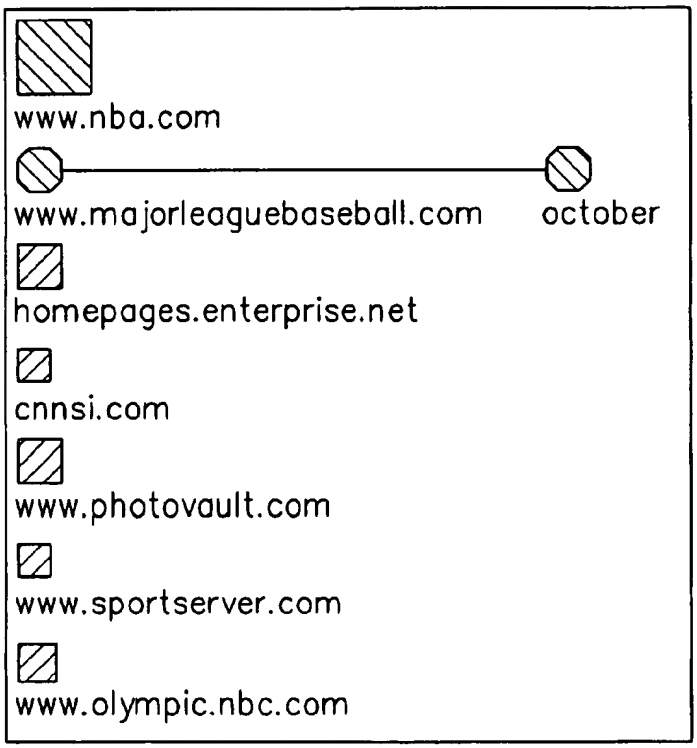
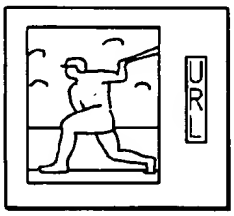


FIG. 4a

Retrieved Images for URL:
www.majorleaguebaseball.com/october/



1 Retrieved Images.

FIG. 4b

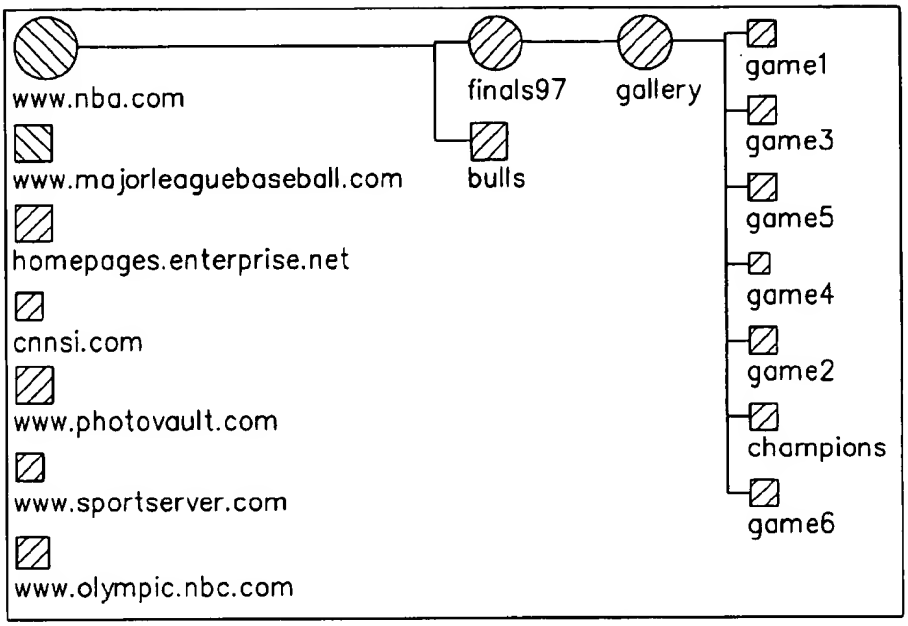


FIG. 5a

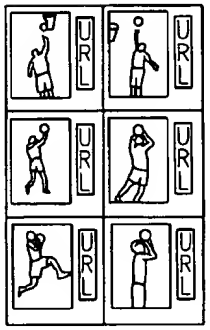


FIG. 5b

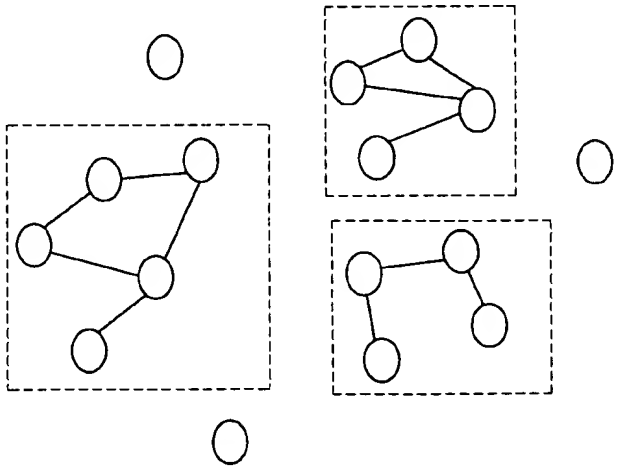


FIG. 6

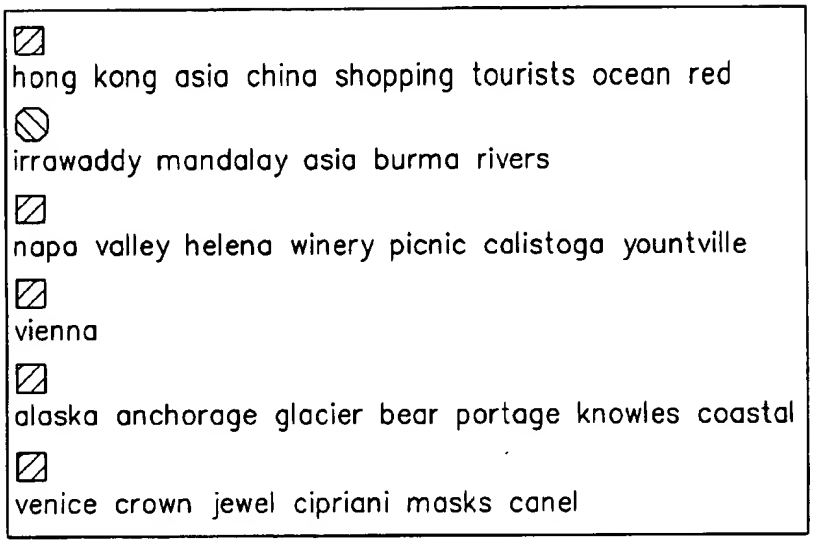


FIG. 7a

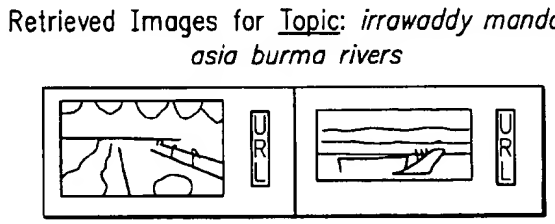


FIG. 7b

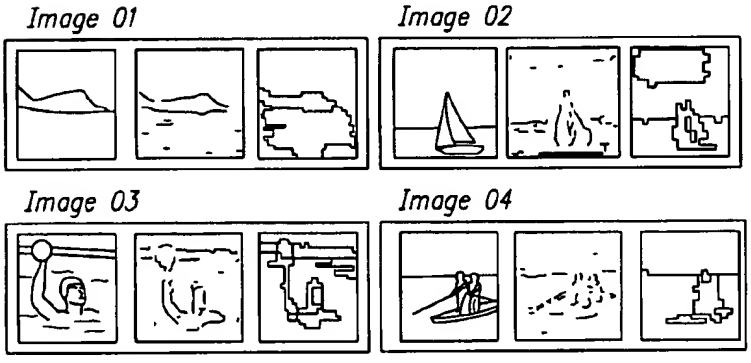


FIG. 8

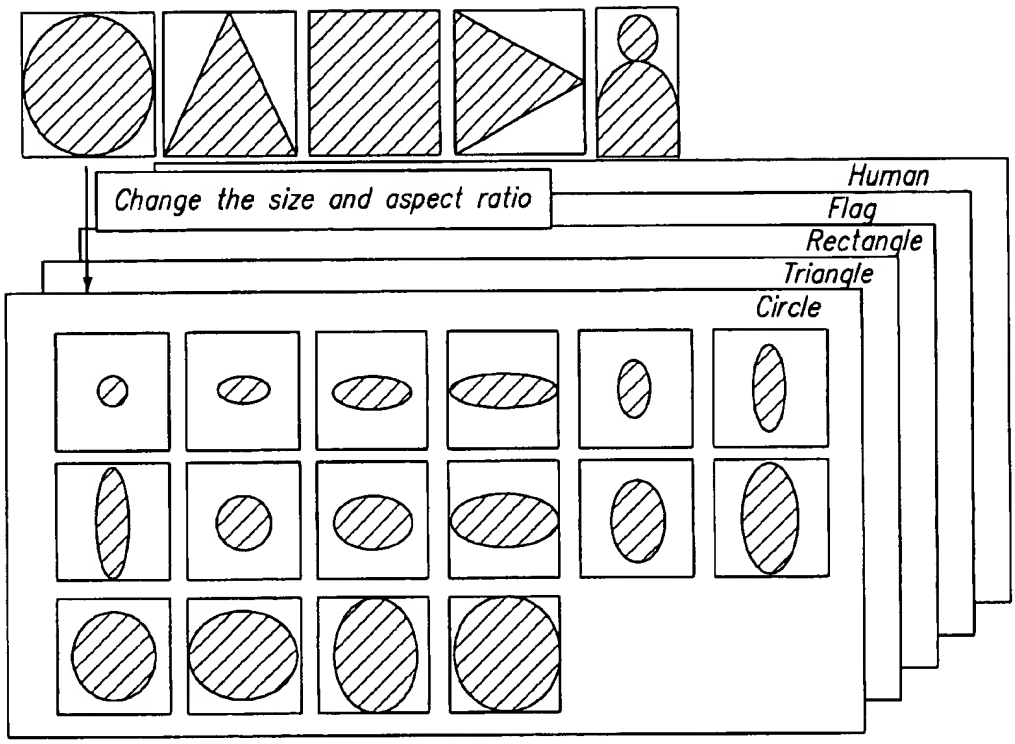

Change the size and aspect ratio
Human
Flag
Rectangle
Triangle
Circle

FIG. 9a

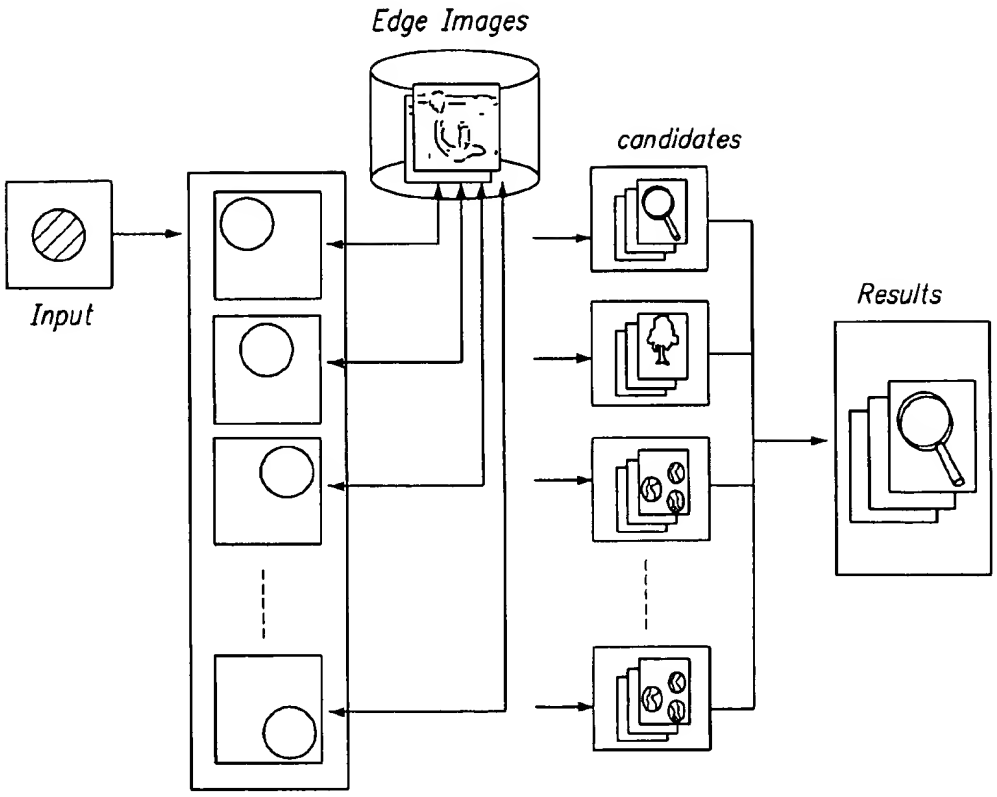


FIG. 9b

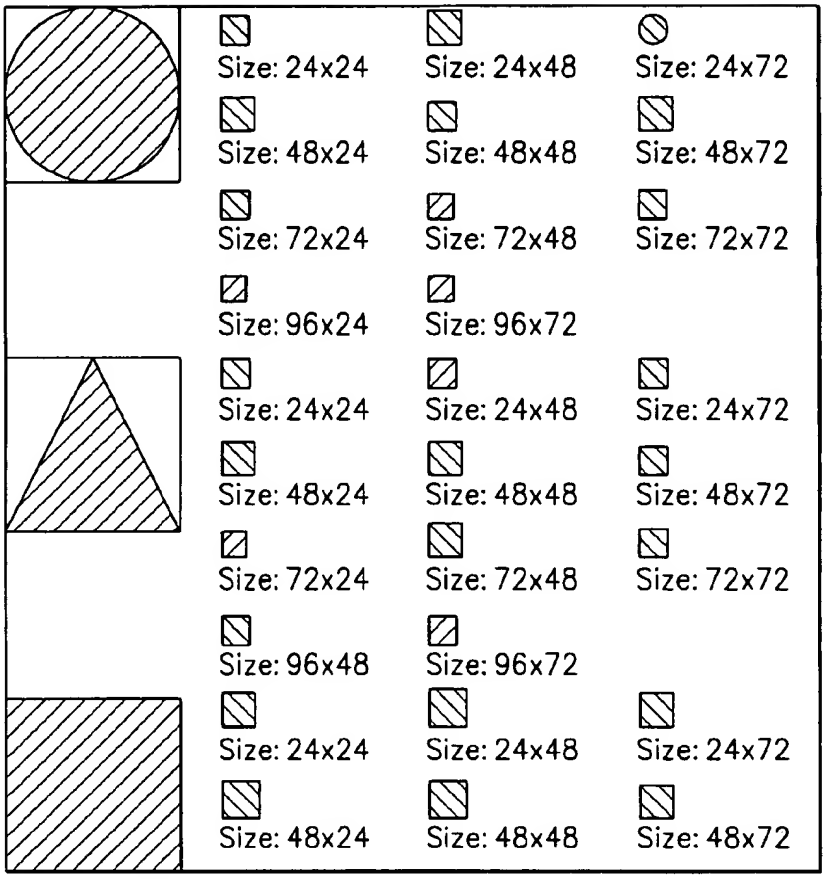


FIG. 10a

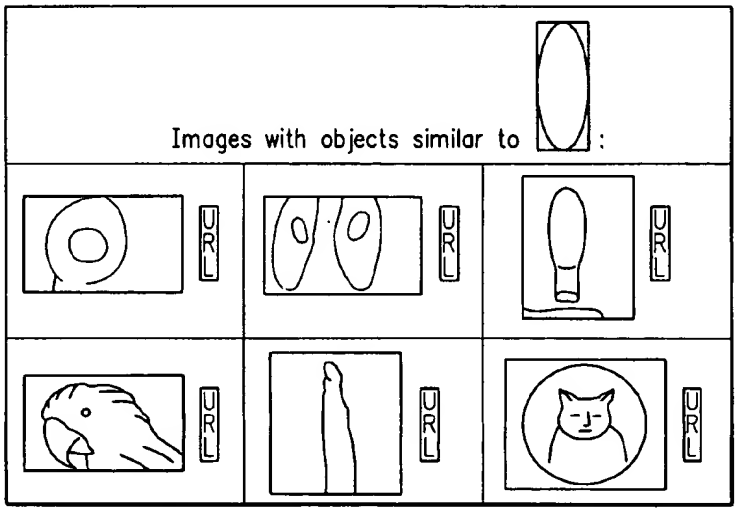


FIG. 10b

METHOD AND APPARATUS FOR QUERY REFINEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of querying a database of images and particularly to providing an interface for organizing the results of queries applied to a database of images.

2. Description of the Related Art

Search engines are some of the most popular and widely accessed sites on the World Wide Web (WWW) because they allow a user to find information of interest. These engines gather textual information about resources on the Web and build up indices. The indices allow for the retrieval of documents containing user specified keywords. Another method of searching for information on the Web utilizes subject-based directories, which provide a useful browsable organization of information.

However, with the explosive growth of information that is available on the WWW, most queries applied to the search engines result in a large number of retrieved documents. This leads to a key limitation suffered by most of the popular search engines available today. More specifically, most search engines show the results of a query as pages of scrolled lists. If a large number of documents are retrieved, scrolling through such lists to find documents of interest to the user is extremely tedious and not at all user friendly.

An image search engine, called Advanced Multimedia Oriented Retrieval Engine (AMORE), developed by the present inventors at NEC, allows the user to specify an image and find images that are visually similar to it. See Mukhetjea et al., "Towards a Multimedia World-Wide Web Information Retrieval Engine," Proceedings of the Sixth International World-Wide Web Conference, pages 177–188, April, 1997. In AMORE the user can specify keywords, where all the images relevant to the keywords are retrieved. However, as more and more images are indexed, AMORE is suffering from the same problems affecting traditional text search engines. More specifically, a query presented by the user of the search engine may result in a large number of retrieved images. Many user queries result in more than 100 retrieved images. As with other search engines, AMORE shows a few of the retrieved images per page and allows the user to go to other pages of retrieved images. This is shown in FIG. 1. Obviously, this is not a very user-friendly way of displaying search results to the user of the search engine.

Various searching and clustering techniques have been proposed to attempt to make systems more user-friendly. However, most have focused on text-based mechanisms. For example, clustering has been an emerging information retrieval tool. See Salton et al., "Introduction to Modern Information Retrieval," McGraw-Hill, 1983; Van-Rijsbergen, "Information Retrieval," Butterworths, 1979. The focus has been on the use of text clustering to speed up the searching process. Instead of comparing all documents in a large collection to find the relevant documents, such efforts have focused on initially comparing only a representative cluster vector for each cluster with the search request. Thereafter, only documents from clusters which matched favorably are compared. Clustering is also useful for browsing large online collections of text as shown by a scatter/gather technique. See Cutting et al., "Scatter/Gather: A Cluster-based Approach to Browsing Large Document Clusters," Proceedings of the ACM SIGIR '92 Conference on Research and Development in Information Retrieval, pages 318–329, June, 1992. Once again, this effort focuses on browsing a text collection, rather than an image collection.

In some instances, clustering has been used for searching large image databases as a pre-processing step to filter out non-interesting images. This reduces the number of images to be processed by more computer-intensive fine matching procedures. In addition, using the classification results produced by clustering, users can roughly grasp the contents of the entire image database and use this information for their interaction with the image retrieval system. Image clustering can be based on various image features such as colors, textures, shapes, etc. For example, Hirata et al., "The Concept of Media-based Navigation and Its Implementation on Hypermedia System "Miyabi,"" NEC Research and Development, 35(4):410–420, 1994, discusses a technique that focuses on color information in an image. Color values from the image are extracted and mapped on the HLS color spaces. Based on the results, users can filter out the images before searching. On the other hand, the work described in Del Bimbo et al., "Shape Indexing by Structural Properties," International Conference on Human Factors in Computing Systems, page 370–377, June, 1997, clusters by shape similarity. Using multi-scale analysis, a hierarchical structure of shape is extracted. Based on this structure, searching capabilities are provided. However, this method assumes that boundary analysis correctly extracts the boundaries of objects in the image. However, this is very difficult to do for WWW images containing many objects. Similarly, image clustering using feature vectors based on moment invariant (See Flickner et al., "Query by Image and Video Content: The QBIC System," IEEE Computer, 28(9):23–31, September, 1995) or boundary features (See Mehrotra et al., "Similar-Shape Retrieval in Shape Data Management," IEEE Computer, pages 57–62, September, 1995) also assumes the correct extraction of objects (or input by a user). Therefore, it is very hard to apply these techniques to the WWW. Additionally, each of these techniques focuses on providing only a single cluster mechanism. The techniques do not address providing a user-friendly interface.

The search techniques are also being applied to the WWW. Research at Xerox Palo Alto Research Center (PARC) uses clustering to extract useful structures from the WWW. See Pirolli et al., "Silk from a Sow's Ear: Extracting Usable Structures from the Web," Proceedings of the ACM SIGCHI '96 Conference on Human Factors in Computing Systems, pages 118–125, April, 1996; Pitkow et al, "Life, Death and Lawfulness on the Electronic Frontier," Proceedings of the ACM SIGCHI '97 Conference on Human Factors in Computing Systems, pages 383–390, March, 1997. The clusters are determined by various criteria like co-citation analysis. Clustering by textual similarity to organize the results of Web text search engines is described in Chang et al., "Customizable Multi-Engine Search Tool with Clustering," Proceedings of the Sixth International World-Wide Web Conference, pages 257–264, April, 1997. However, such implementations also fail to provide a user friendly user interface.

Examples of interfaces which have been developed for viewing information retrieval results include SenseMaker (See Baldonado et al., "SenseMaker: An Information-Exploration Interface Supporting the Contextual Evolution of a User's Interest," Proceedings of the ACM SIGCHI '97 Conference on Human Factors in Computing Systems, pages 11–18, March, 1997) and Cat-a-Cone (See Hearst et al., "Cat-a-Cone: An Interactive Interface for Specifying Searches and Viewing Retrieval Results using a Large

Category Hierarchy," Proceedings of the ACM SIGIR '97 Conference on Research and Development in Information Retrieval, July, 1997). These articles, as well as those discussed above are hereby incorporated herein by reference.).

SenseMaker is an interface for information exploration across heterogeneous sources in a digital library. SenseMaker allows the user to interactively change the level of granularity and the organizational dimensions of a collection of documents that match the user's interest. Cat-a-Cone is a 3D interface that allows a user to search and browse a large category hierarchy and the associated documents. The documents and the categories can be viewed concurrently. However, as with other systems, SenseMaker and Cat-a-Cone both focus on the text properties of documents and also present differing text organizational structures.

Other Web Image Search engines, such as Excalibur's Image Surfer (http://isurf.yahoo.com) and Webseer (http://webseer.cs.uschicago.edu) show retrieved images in successive HTML pages. However, no technique for organizing the search results or query refinement is possible. Other popular text search engines, such as Alta Vista (http://www.altavista.digital.com) and Excite (http://www.excite.com) allow query refinement. Excite can group search results by Web sites. Moreover, both Excite and Alta Vista use co-occurrence analysis to show other relevant keywords for the query terms. While the technique is useful, there is no mechanism to find out the actual documents that correspond to the different keywords. The keywords are merely used to refine a search by including or excluding them. Allowing the user to see the actual documents/images that belong to a cluster would be more useful.

SUMMARY OF THE INVENTION

To overcome these and other difficulties, the present invention is directed to a method and apparatus for providing an interface for query refinement. The present invention provides to a user of a search engine a Query Result Visualization Environment (QRVE), a user interface which allows the user to refine the results of an original query by using variously clustered results of the original query. The results may be clustered using text, a primary object (or shape) or universal resource locator (URL). The members of the clusters may then be used to formulate the refined queries.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. **1** shows the results of a traditional search using the AMORE search engine.

FIG. **2** shows the results of a combined image and keyword query.

FIG. **3** shows the architecture of the system implementing the present invention.

FIGS. **4**(*a*) and **4**(*b*) show search results grouped according to URL and an image from a selected URL in accordance with an embodiment of the present invention.

FIGS. **5**(*a*) and **5**(*b*) show the hierarchical structure of a web site and images from a selected section of the web site.

FIG. **6** shows the text cluster formation technique in accordance with an embodiment of the present invention.

FIGS. **7**(*a*) and **7**(*b*) show search results grouped according to keyword, along with the images for one of the groups, in accordance with an embodiment of the present invention.

FIG. **8** shows the results of an object extraction procedure used to categorize images by objects.

FIGS. **9**(*a*) and **9**(*b*) shows templates used to cluster images by primary object and also shows the clustering procedure.

FIGS. **10**(*a*) and **10**(*b*) shown search results grouped according to primary object, along with the images for one of the groups, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of a method and apparatus for providing an interface for refining a query, according to the present invention, is described below in detail with reference to the accompanying drawings. It is to be noted that while the following discussion is presented in the context of the AMORE search engine, the present invention is not so limited. The present invention may be applied to a variety of search engines for the WWW, multimedia databases, etc.

A brief overview of how a search engine, such as AMORE, operates is first presented. Implementing a search engine involves two phases, indexing and querying. Several systems exist that allow full-text indexing of Web sites. The indices allow the user to search the indexed sites using any combination of keywords. Systems that can index images in a database based on various image characteristics, such as shape and color have also been developed. Image indexing allows for the retrieval of images in the database that are similar to a user specified image. AMORE integrates the two types of systems by allowing for the retrieval of Web documents containing one or more keywords and/or images similar to a user specified image. FIG. **2** shows the results of a search in which an integrated keyword and image query was issued.

The first step to implementing a search engine involves indexing the database of Web sites, documents or images. After text and/or image indices have been built, users can issue queries. The queries can contain one or more keywords or an image. The text and image search can also be combined by using Boolean logic (e.g. "and" or "or"). However, a problem arises when the database to be searched becomes very large. Queries may result in a large number of retrieved images.

The present invention provides an interface to the user of a search engine for refining queries. The interface, called a Query Result Visualization Environment (QRVE), allows the results of a search to be organized in various ways. For example, the images retrieved as a result of a search query can be grouped or clustered by the Web sites (URL) from which they were retrieved, by how many keywords they have in common, or by their composition, where images with similar composition form a single cluster.

In accordance with the present invention, when a user issues a query, the user has the option of grouping the results in one of several ways, for example, by URL, text (or keywords) or composition. The QRVE is a graphical user interface (GUI) presented to the user of a system upon the execution of a query. The QRVE presents to the user the cluster information for the retrieved images, where the results are clustered or grouped in accordance with the grouping method selected by the user. Each cluster is represented in the QRVE by a glyph (graphical element). When the user requests the details of a cluster, by clicking on the glyph representing the cluster, the images of the cluster are shown to the user. The clustered search results of

the initial query issued by the user may then be used to refine the search. The details of refinement will be discussed below.

The architecture of a system upon which the present invention may be implemented is shown in FIG. **3**. After the AMORE search engine completes indexing the images in the keyword and image indices, the cluster generator uses the keyword and image clustering algorithm to generate the text and image clusters, respectively. The QRVE Facilitator retrieves the cluster information for images retrieved in response to a query. This information is used to create the visualization, where each cluster is represented by a glyph. When the user clicks on a glyph representing a particular cluster, a request is sent by the QRVE applet to the facilitator. The facilitator interacts with the text and image clusters to determine the images for the cluster clicked by the user. Those images are shown in the results frame of the client browser.

The details of each of the methods of clustering will now be discussed. First, grouping by URL will be discussed. Suppose a user is interested in a picture of a baseball player whose last name is "Jordan." Unfortunately, she does not remember his first name. If a keyword search is initiated with the last name "Jordan" in the sports category of a search engine, a large number of images is retrieved. Not surprisingly, most of the retrieved images are of basketball star Michael Jordan. Browsing through all of the retrieved images to find the one desired by the user can be painful. The QRVE of the present invention provides a solution, as shown in FIGS. **4**(*a*) and **4**(*b*), which show two parts of a window. Initially, it is assumed that the user chose the method of clustering the query search results by URL. The window in FIG. **4**(*a*) shows the search results categorized by URLs clusters for the images retrieved. Each URL cluster is represented by a glyph. The QRVE for the keyword only search using the term "Jordan" shows that images from seven Web sites were retrieved. The desired image of the baseball player will most probably be in the web site www.majorleaguebaseball.com. When the user clicks on the glyph associated with this web site, the retrieved picture of baseball player Brian Jordan is shown in FIG. **4**(*b*). The user can then initiate a refined search using this image of Brian Jordan as the query.

The hierarchical structure of web sites from which images are retrieved may also be shown to the user. This is especially useful if a large number of images from one particular web site are retrieved. For example, for the keyword only search using the term "Jordan", many images of Michael Jordan are retrieved from the web site www.nba.com. When the user clicks on the glyph associated with this web site, the images and the directory structure of the web site are shown in a results frame. If the user is only interested in images from the 1997 NBA finals, she can click on the glyph for the subdirectory finals 97. The resultant scenario is shown in FIGS. **5**(*a*) and **5**(*b*), which together comprise a window. Note that in FIG. **5**(*a*) the glyph is a circle on the path chosen by the user and is a square for other paths. The size of the glyph is proportional to the number of images retrieved in the cluster. The cluster of images is shown in FIG. **5**(*b*). Additionally, the color of the glyph may be comprised of two basic color components, where the magnitude of the first color component is proportional to the maximum number of keywords in the documents containing the retrieved images of the group which is represented by the glyph. The magnitude of the second color component is proportional to the maximum image similarity.

If images from many unknown web sites are retrieved, or if a search is simply being performed on a database of images, clustering by URL is not very useful. Instead, clustering by keywords may be used. The text clustering procedure is explained as follows.

Several preprocessing steps are carried out. First, during an index phase, various heuristics are used to assign keywords to images. The image name, the title of the page from which the image came, and a section of the text before and after the image are assigned to the image.

Second, the documents are represented in a vector space model. For example, let V be the set of unique words assigned to the images of a category. Then each image can be represented by a vector of length $|V|$ in which the absence of a word is indicated by 0 and the presence of a word is indicated by a positive number, known as term weight. The term weight reflects the importance of the word for the image. Traditional text retrieval using Inverse Document Frequency as the term weight has been found to be quire effective. See Salton et al., "Introduction to Modem Information Retrieval," McGraw-Hill, 1983. In the present invention, the term weight of a word is determined not only by its frequency but also by where it occurs. Thus, if a word occurs in the name of the image itself, its term weight will be greater than for a word occurring in the text surrounding the image. Note that before forming the vectors, universal common words, such as "and" and "the" are removed, as well as words that are very common (occurring in more than half the documents) for the category (like the terms "game" and "team" in the "sports" category).

Third, a similarity matrix is formed by calculating the similarity between each pair of images. The similarity between two images is measured by the cosine of the angle between the vectors representing them. This is normalized so that, for each pair of images, the similarity is a value between 0 and 1. If a category has a large number of images, the matrix will be huge. Therefore, in accordance with the present invention, a sparse matrix is used and the similarity value is stored only if it is greater than a threshold.

Fourth, clustering is described as follows in conjunction with FIG. **6**. Each image is considered to be a node in a graph, shown in FIG. **6** as a circle. A link, shown in FIG. **6** as a line connecting nodes, exists between two nodes in the graph if the similarity between the two corresponding images is greater than a threshold. Initially, the threshold is set at 0.1. Then the connected components in the graph are found. A connected component is a set of nodes such that each node is linked to at least one other member of the set, shown by the dotted rectangles in FIG. **6**. The set of nodes is selected to be as large as possible, i.e. all of the connected nodes are selected to be part of the connected component. The set of nodes in a connected component form a cluster. This single-link cluster formation technique has been extensively used in information retrieval and found to be one of the most appropriate. See Van-Rijsbergen, "Information Retrieval," Butterworths, 1979, Chapter 3 for details. Then, if a cluster contains a large number of documents and the threshold value is less than the maximum possible value of 1.0, the threshold value is increased by 0.05 and the above clustering process is repeated until a desirable number of documents is contained in the cluster.

Fifth, cluster topics are determined. The clusters are represented in the QRVE by the main topic of the clusters. The topic of a cluster is determined by the words that appear in most of the images of the cluster. Since adverbs, prepositions, etc. are not very interesting, they are not allowed to be cluster topics. Wordnet can be used to determine the figure of speech of a word. See Miller, "Wordnet:

A Lexical Database for English," Communications of the ACM, 38(11):39–41, November, 1995. Moreover, if a word appears as a topic in many clusters, it is removed as a topic word.

Grouping by keywords is useful to semantically organize the images retrieved for an image search, as shown in FIG. 7(*a*). Each cluster is represented by a glyph and the main topics of the cluster are shown at the bottom of the glyph. From the cluster topics, the user gets an idea of the types of images that will be present in the cluster. For example, the cluster with the topics "burma", "irrawady", etc. will have pictures of Burma (the Irrawady is a river in Burma) as shown in FIG. 7(*b*), where FIGS. 7(*a*) and 7(*b*) together occupy a window. Besides issuing another search with a retrieved image from one of the clusters, the user can also refine the search by looking at all the images of a cluster. Since the clusters are formed by text analysis, by refining, text and image searching are smoothly integrated. Even if the user does not combine text and image searching during the querying phase, they are combined during the browsing phase. It should be noted that text clustering is also useful to organize the results of a keyword search if many images are retrieved.

Yet another clustering option provided in the QRVE is by image composition. During image indexing, AMORE extracts the visual characteristics of the images automatically for content-based image retrieval. The present invention focuses on the compositional similarity of the objects in the images during clustering. To classify the images based on the composition of the objects, two steps are required. First, the objects must be extracted from the images. To do this, edges are detected from the image. This edge image is used to extract the objects from the image using color, location and visual features.

FIG. **8** explains the object extraction procedure with the help of four sets of images. The left images of the sets are the original images, the center images are the edge images and the right images represent the extracted objects from the images. As seen from the right images, the airplane from the image **01** and the yacht from image **02** were successfully extracted. The algorithm also extracted the clouds and sky from image **01** and clouds, sea and sky from image **02**. However, the person in image **03** was divided into two regions because of the different color elements. In image **04**, the two persons were merged into one region because of the closeness of the color, texture and position of each person. These gaps between the visual characteristics and semantic meaning of the image can lead to an image classification that is not expected by the users. In order to reduce region division and region merge effects and provide intuitive results, the edge images are used directly to evaluate the boundary of the objects.

Once the objects are extracted from the images, the second step is to evaluate the composition of the objects and cluster images based on the evaluation. Usually, there exist many different objects in one image and sometimes it is hard to extract the objects correctly. In addition, the objects contained in the images have a wide variety of shapes of different sizes. Due to these reasons it is very difficult to determine the cluster automatically, based upon the distribution of the visual attributes. Therefore, typical primary shapes like ellipses, rectangles and triangles of different sizes and aspect ratios are defined as templates and are used as clustering seeds to make a classification. Some of these templates are shown in FIG. 9(*a*).

The clustering process uses a comparison algorithm to match the edge images with the input templates as shown in FIG. 9(*b*). The objects in the images do not usually have the same shape as the templates. There might exist some unevenness and the size might be different. In order to allow some flexibility, the algorithm considers the local correlation among the data during the comparison. The details of the comparison algorithm can be found in related application Ser. No. 09/064,061, the contents of which are incorporated herein by reference, entitled "Method and Apparatus for Image Querying Using Object Boundaries" to K. Hirata and assigned to the assignee of the present application.

To achieve location independence, several sets of images are created from the templates by shifting the objects and the comparison algorithm is called for each as shown in FIG. 9(*b*). Since the algorithm also allows for noise, images are created for every 15% shifting, for example. For each image of a category, a score determines its similarity to a template image of a given size and aspect ratio. If the score is greater than a threshold, the image belongs to the corresponding cluster.

An example of image clustering is shown in FIGS. 10(*a*) and 10(*b*). Each image cluster is represented by a glyph in FIG. 10(*a*). The template image for the cluster is shown on the right and the size of the template that corresponds to a cluster is displayed at the bottom of the cluster's glyph. The size, shape and color of the glyphs are determined by the criteria described above. The user can click on a glyph to find the retrieved images containing objects similar to the template image of the given size and aspect ratio. It is also possible to retrieve all images for a cluster. For example, the top 6 images having an object similar to a 24×72 ellipse are shown in FIG. 10(*b*). Since querying is by keyword and the clustering is by image shape similarity, this gives the user another way of combining text and image searching. It should be noted that image clustering could also be used to organize the results of an image search.

Thus, in accordance with the present invention, a user of a search engine is provided with a method and apparatus for providing a user with an interface for refining the results of an original query by clustering the results of the original query in various ways.

Other modifications and variations to the invention will be apparent to those skilled in the art from the foregoing disclosure and teachings. Thus, while only certain embodiments of the invention have been specifically described herein, it will be apparent that numerous modifications may be made thereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A method for refining a first query applied to a database of images, the method comprising the steps of:

selecting one of a plurality of modes of clustering results of the first query, wherein the modes of clustering include clustering by one of text, image and Universal Resource Locator (URL); and

retrieving cluster groups containing the results of the first query, the cluster groups having been clustered in accordance with the selected mode of clustering, wherein when the selected mode of clustering is clustering by text, the cluster groups have been formed in a preprocessing procedure comprising the steps of:

(a) representing each of the images in the database in a vector space model, where V represents a unique set of keywords assigned to the images, where each of the images is represented by a vector of length |V|;

(b) calculating a similarity value between each pair of the images, thereby forming a similarity matrix,

wherein the similarity value is measured by the cosine of the angle between the vector of the respective images, the similarity value being further normalized to a value between 0 and 1;

(c) storing the similarity value in the similarity matrix only when the similarity value is greater than a first threshold value;

(d) clustering the images based on the normalized similarity value; and

(e) determining a topic for each of the cluster groups; and

the method for refining a first query filer comprising displaying the cluster groups, each of the cluster groups being visually represented by a graphical element; and

refining the results of the first query using members of the cluster groups as elements of a refined query.

2. The method according to claim **1**, wherein the database of images is a multimedia database.

3. The method according to claim **1**, wherein te database of images is on the World Wide Web.

4. The method according to claim **1**, wherein clustering by image includes clustering by color.

5. The method according to claim **1**, wherein clustering by image includes clustering by primary shape.

6. The method according to claim **1**, wherein the length |V| is calculated so that the absence of one of the keywords is indicated by a 0 and the presence of one of the keywords is indicated by a positive number representing the importance of the keyword, the frequency of assignment of the keyword in the image.

7. The method according to claim **1**, wherein the preprocessing step further comprises the steps of:

(a) determining linking nodes, where each of the images is represented by a node, wherein nodes are linking nodes when the normalized similarity value between the pair of images is greater than a second threshold value;

(b) determining a set of connected components, the set of connected components being a set of the nodes where each of the nodes is linked to at least one other member of the set of nodes, the set of nodes in a connected component forming a cluster; and

(c) repeating steps (a) and (b) by increasing the second threshold value when the cluster contains a large number of the images and the second threshold value is less than a maximum value of 1.0.

8. The method according to claim **1**, wherein the step of determining a topic for each of the cluster groups comprises determining the keywords which are assigned to most of the images of the cluster.

9. The method according to claim **1**, wherein the step of refining further comprises the steps of:

(a) selecting the graphical element representing a desired cluster group;

(b) displaying the members of the selected cluster group; and

(c) selecting one of the displayed members as one of the elements of the refined query.

10. The method according to claim **1**, wherein, when the selected mode of clustering is clustering by image, the cluster groups have been formed in a preprocessing procedure comprising the steps of:

(a) detecting edge images of each of the images in the database;

(b) comparing the edge images of each of the images with primary shape cluster templates; and

(c) grouping the images into cluster groups by primary shape based upon similarity between the edge images of each of the images and the primary shape cluster templates.

11. The method according to claim **10**, wherein the step of comparing compensates for unevenness in the edge images, small size differences between the edge images and the primary object cluster templates and shifting of objects in the images.

12. The method according to claim **10**, wherein the step of grouping further comprises grouping into cluster groups by different sizes of the primary shape cluster templates.

13. The method according to claim **12**, wherein the step of refining further comprises the step of selecting the graphical element representing a desired cluster group indicating a desired size of a desired primary shape cluster template.

14. The method according to claim **1**, wherein when the selected mode of clustering is clustering by URL, the cluster groups have been formed by grouping the results by web sites from which the results come, wherein each web site represents one of the cluster groups.

15. The method according to claim **14**, wherein a directory structure is shown for the web site represented by the graphical element representing a selected cluster group.

16. The method according to claim **14**, wherein the step of refining further comprises the steps of:

(a) selecting the graphical element representing a desired cluster group;

(b) displaying the members of the selected cluster group; and

(c) selecting one of the displayed members as one of the elements of the refined query.

17. The method according to claim **1**, wherein the graphical element is a first shape when it is not selected and the graphical element is a second shape when it is selected.

18. The method according to claim **1**, wherein a size of the graphical clement is proportional to the number of the members in the cluster group represented by the graphical element.

19. The method according to claim **1**, wherein the graphical element is comprised of a first color component and a second color component, where the first color component is proportional to a maximum number of desired keywords in the members of the cluster group represented by the graphical element and where the second color component is proportional to a maximum image similarity between the first query and the members of the cluster group represented by the graphical element.

20. A system for refining a first query applied to a database of images, the system comprising:

a first computer, including a display; and

a second computer executing an application program for providing a user of the computer with an option of selecting one of a plurality of modes of clustering results of the first query, wherein the modes of clustering include clustering by one of text, image and Universal Resource Locator (URL); wherein the first query is executed and the cluster groups containing the results of the first query are retrieved, the cluster groups having been clustered in accordance with the selected mode of clustering; wherein, the cluster groups are displayed on the display, each of the cluster groups being visually represented by a graphical element; wherein the user may refine the results of the first query using members of the cluster groups as elements of a refined query; and wherein, when the selected mode of

clustering is clustering by text, in the application program, the cluster groups have been formed in a preprocessing procedure by:

(a) representing each of the images in the database in a vector space model, where V represents a unique set of keywords assigned to the images, where each of the images is represented by a vector of length |V|;

(b) calculating a similarity value between each pair of the images, thereby forming a similarity matrix, wherein the similarity value is measured by the cosine of the angle between the vector of the respective images, the similarity value being further normalized to a value between 0 and 1;

(c) storing the similarity value in the similarity matrix only when the similarity value is greater than a first threshold value,

(d) clustering the images based on the normalized similarity value; and

(e) determining a topic for each of the cluster groups.

21. The system according to claim **20**, wherein the first computer and the second computer are the same computer.

22. The system according to claim **20**, wherein the first computer is a client computer and the second computer is a host computer connected to the client computer.

23. The system according to claim **20**, wherein the database of images is a multimedia database.

24. The system according to claim **20**, wherein the database of images is on the World Wide Web.

25. The system according to claim **20**, wherein clustering by image includes clustering by color.

26. The system according to claim **20**, wherein clustering by image includes clustering by primary shape.

27. The system according to claim **20**, wherein the length |V| is calculated so that the absence of one of the keywords is indicated by a 0 and the presence of one of the keywords is indicated by a positive number representing the importance of the keyword, the frequency of assignment of the keyword in the image.

28. The system according to claim **20**, wherein in the application program, the preprocessing procedure further comprises:

(a) determining linking nodes, where each of the images is represented by a node, wherein nodes are linking nodes when the normalized similarity value between the pair of images is greater than a second threshold value;

(b) determining a set of connected components, the set of connected components being a set of the nodes where each of the nodes is linked to at least one other member of the set of nodes, the set of nodes in a connected component forming a cluster; and

(c) repeating (a) and (b) by increasing the second threshold value when the cluster contains a large number of the images and the second threshold value is less than a maximum value of 1.0.

29. The system according to claim **20**, wherein a topic for each of the cluster groups is created by determining keywords which are assigned to most of the images of the cluster.

30. The system according to claim **20**, wherein in the application program, the results are refined by:

(a) selecting the graphical element representing a desired cluster group;

(b) displaying the members of the selected cluster group on the display; and

(c) selecting one of the displayed members as one of the elements of the refined query.

31. The system according to claim **20**, wherein, when the selected mode of clustering is clustering by image, in the application program the cluster groups have been formed in preprocessing procedure by:

(a) detecting edge images of each of the images in the database;

(b) comparing the edge images of each of the images with primary shape cluster templates; and

(c) grouping the images into cluster groups by primary shape based upon similarity between the edge images of each of the images and the primary shape cluster templates.

32. The system according to claim **31**, wherein the comparing compensates for unevenness in the edge images, small size differences between the edge images and the primary object cluster templates and shifting of objects in the images.

33. The system according to claim **31**, wherein the grouping groups into cluster groups by different sizes of the primary shape cluster templates.

34. The system according to claim **33**, wherein results are refined by further selecting the graphical element representing a desired cluster group indicating a desired size of a desired primary shape cluster template.

35. The system according to claim **20**, wherein when the selected mode of clustering is clustering by URL, in the application program, the cluster groups have been formed by grouping the results by web sites from which the results come, wherein each web site represents one of the cluster groups.

36. The system according to claim **35**, wherein a directory structure is displayed on the display for the web site represented by the graphical element representing a selected cluster group.

37. The system according to claim **35**, in the application program, the results are refined by:

(a) selecting the graphical element representing a desired cluster group;

(b) displaying the members of the selected cluster group on the display; and

(c) selecting one of the displayed members as one of the elements of the refined query.

38. The system according to claim **20**, wherein the graphical element is a first shape when it is not selected and the graphical element is a second shape when it is selected.

39. The system according to claim **20**, wherein a size of the graphical element is proportional to the number of the members in the cluster group represented by the graphical element.

40. The system according to claim **20**, wherein the graphical element is comprised of a first color component and a second color component where the first color component is proportional to a maximum number of desired keywords in the members of the cluster group represented by the graphical element and where the second color component is proportional to a maximum image similarity between the first query and the members of the cluster group represented by the graphical clement.

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